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Analysis of factors contributing to roadside tree crashes in South Carolina

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ANALYSIS OF FACTORS CONTRIBUTING TO ROADSIDE TREE CRASHES IN SOUTH CAROLINA

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by
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ABSTRACT

The state of South Carolina has experienced a large number of fatalities and injuries resulting from run off the road tree related crashes. According to 2008 FARS data tree related fixed object fatal crashes in South Carolina (65%) are more than double that of the national (25.8%). Thus, trees are much bigger proportion of all roadside hazards in South Carolina than nationally. In order to achieve a safer roadside which is favorable to the road user, factors contributing to the tree related crashes should be critically analyzed to determine suitable safety improvements.

This research aims at qualitatively and quantitatively assessing tree related crashes in SC and performing an in depth study of the problem to determine potential countermeasures to increase safety of the roadside environment. Various descriptive statistics were computed to determine any significant contribution of crash characteristics using the police accident reports database obtained from SCDOT from the years 2004 to 2006. Detail analysis of clear zone adequacy and possible slope issues were performed using the roadside inventory data collected from "Support for Elimination of Roadside Hazards" project.

The analysis revealed that tree related crashes in SC were predominantly related to young male drivers, secondary roads and speeding. Over a large portion of fatal crashes involved young male drivers speeding under the influence of alcohol/drugs during poor visibility or dark conditions. Clear zone adequacy analysis revealed that majority of the sites did not meet minimum clear zone requirements indicating, if a tree-

crash pattern exists, it is likely that minimum clear zones are not met. A larger part of the sites analyzed had traversable side slopes and clear zone width was the only problem.

DEDICATION

I dedicate this work to my loving parents, Gangadhar Bendigeri and Sarojini Bendigeri who inspired me to take this enlightening path. Their continuous support made this work possible.

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This thesis arose in part out of years of research that has been done since I came to Clemson University. By that time, I have worked with many people whose contribution in assorted ways to the research and making of this thesis deserves special mention. It is a pleasure to convey my gratitude to them all in my humble acknowledgement.

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CHAPTER 1

INTRODUCTION

1.1 Introduction:

Every year approximately 15,000 people are killed and another million are injured in crashes on our roadsides (4). According to a comprehensive analysis done by Viner these roadside crashes cost our society an estimated amount of $110 billion annually (26). The 2008 statistics from the Fatality Analysis Reporting System (FARS) show that 33 percent of 34,017 fatal crashes involved single-vehicle leaving the roadway and hitting a roadside hazard. A roadside hazard is defined as "any fixed object by the side of the road that, by virtue of its structure and placement, results in or is likely to result in, an increased probability of vehicle damage, occupant injury or fatality in the event of a motor vehicle leaving the roadway," (Severe and Fatal Car Crashes Due to Roadside Hazards). Roadside hazards may include trees, poles, bridges, culverts, guardrail, embankment, curb, fence, wall, building and others.

According to the 2008 FARS data for fixed object crashes on all roadway classes, the first harmful event is likely to be impacting a tree is 25.8%, and impacting a utility pole is 7.9%. According to FARS data for 2008, out of 11,233 fatal fixed object crashes, 2900 involved trees, 1188 ditches, 1120 embankments, 892 were poles and 231 were bridge crashes. Among all of the roadside hazards trees are the objects most commonly struck, and the impact severity is generally very high.

Figure-1 shows the distribution of fatal crashes based on the roadway functional classification. Rural roads accounted for approximately 62% of fatal crashes against 37% on urban roads. About 24% of all the fatal tree crashes occurred on the rural major and minor roads followed by 16% on rural locals and urban principal arterials.

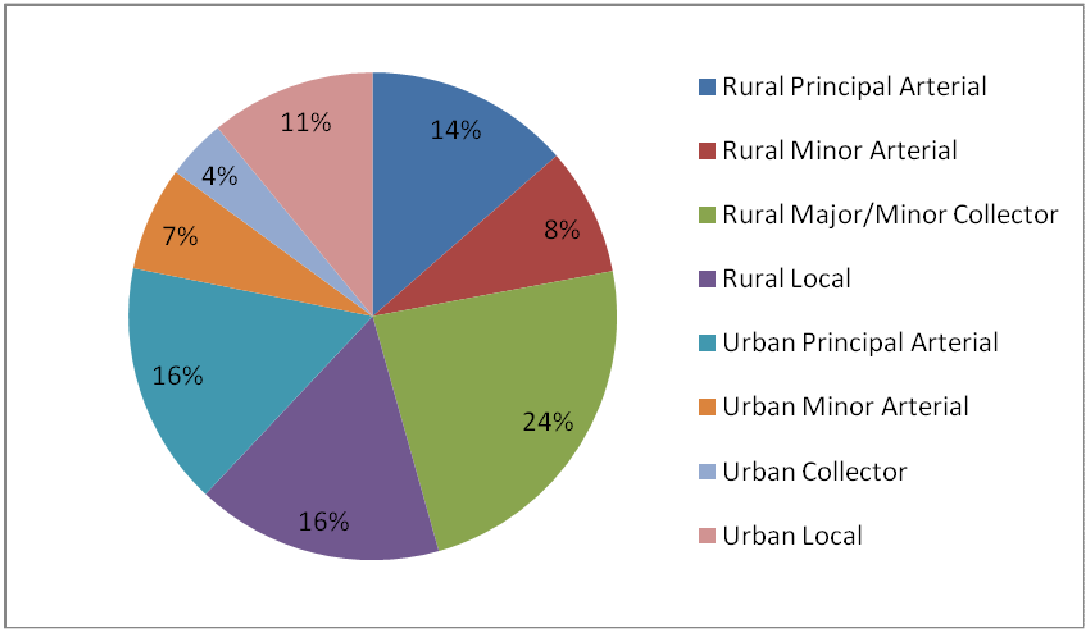

Figure-1, Fatal Tree Crashes by Functional Class (2008 FARS data)

Out of 2900 fatal tree crashes approximately 90% of them occurred on the two-lane roads and about 5% occurred on the four-lane roads (Figure-2).

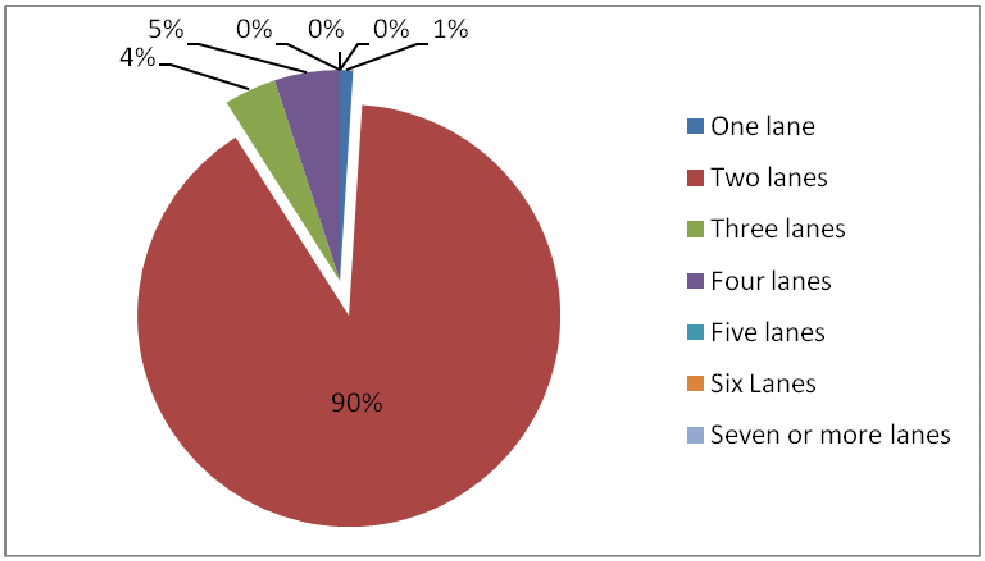

Figure-2, Fatal Tree Crashes by Number of Travel Lanes (2008 FARS data)

Tree crashes are also strongly associated with roadway geometry, traffic volume and overall road condition. Zegeer et al. (1990) in his study found that for an average daily traffic (ADT) of 1,000 vehicles per day (vpd) or less, 22 to 24 percent of fixed-object crashes involved striking a tree. Thus in order to significantly improve roadside safety due consideration should be given to reduce number of tree related roadway crashes.

1.2 Problem Statement:

The state of South Carolina has experienced large numbers of fatalities and injuries resulting from fixed objects crashes. In 2008 out of 840 fatal crashes in South Carolina 276 i.e. 33% involved hitting a roadside hazard (FARS Data). Of these fixed object crashes 178 struck trees (65%), 32 struck culvert/ditch/embankment (12%), 22 stuck utility poles (8%) and 6 were bridge crashes (2%). Thus, making tree crashes the worst among all the other fixed object crashes.

Figure-3 shows the distribution of fatal tree crashes based on the function classification. Rural roads account for 96% of the fatal crashes against 4% urban roads. And 99% of these crashes occurred on rural two lane roadways (2008 FARS Data).

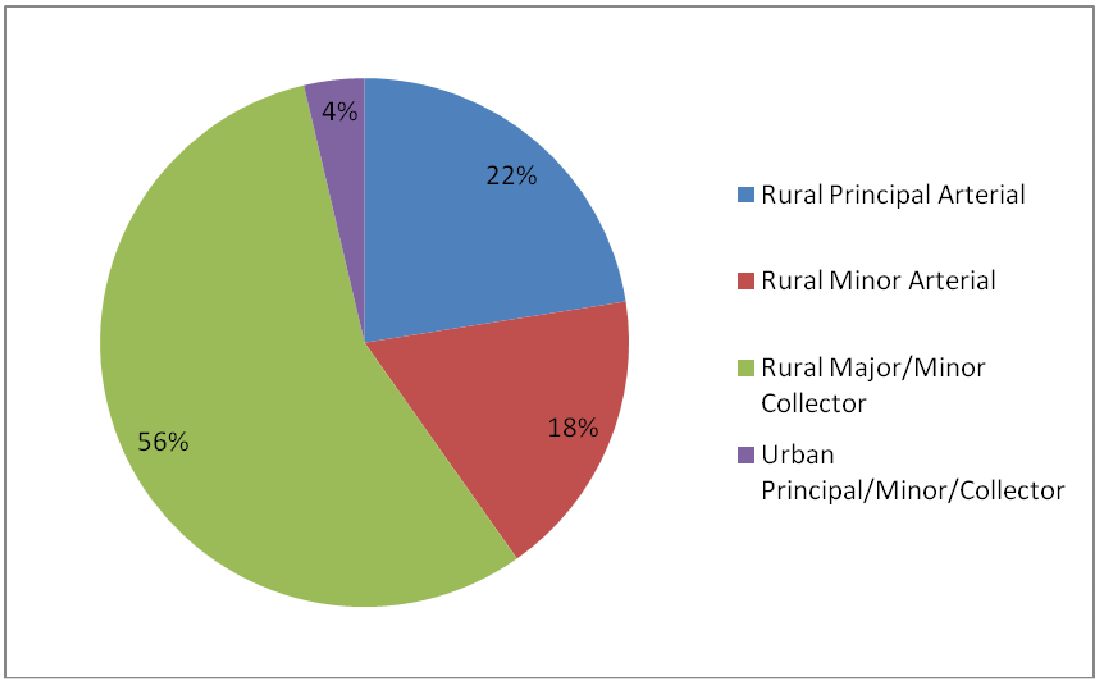

Figure-3, Fatal tree crashes in South Carolina by functional class (2008 FARS Data)

These figures justify the seriousness of tree crash problem in South Carolina. Tree related fixed object fatal crashes in South Carolina (65%) are more than double that of national (25.8%). Thus, in order to achieve a safer roadside which is favorable to the road user, the issues and factors contributing to the tree crashes should be critically analyzed to determine suitable safety improvements.

1.3 Goals and Objectives:

The goal of this research is to qualitatively and quantitatively assess tree related crashes in South Carolina and perform in depth study of the problem and potential countermeasures to increase safety of the roadside environment.

The complexity of this problem requires a multi-objective approach as follows:

- Define the magnitude of tree crash problem in South Carolina
- Assess existing literature on tree crashes and counter measurements
- Analyze various factors associated with the tree crashes
- Evaluate clear zone sufficiency using existing data from the Support for Elimination of Roadside Hazards project
- Perform in depth analysis for sites where extensive clear zone data was collected
- Define range of potential Benefit/Cost ratios for implementing clearing and other countermeasures and propose frame work for making recommendations for countermeasures implementation
- Establish a priority ranking method for tree crashes based on existing data and identify hazardous sites and road stretches in South Carolina.

1.4 Organization of the Thesis:

The remaining chapters of this thesis describe the work completed to meet the objectives of the research. Chapter 2 provides a brief literature review of various factors and issues related to tree crashes and summarize various strategies

to improve safety with respect to trees and effectiveness of countermeasures. It will discuss in brief various action plans taken out by different states to improve the clear zone safety and comparison with the state of South Carolina. Chapter 3 discusses the approach and methodology dealing with analysis of existing data using three year police crash database (2004-2006), computation of various crash characteristics, analysis of factors affecting clear zone, benefit/cost analysis of clearing trees and crash ranking matrix. Chapter 4 presents various problems and issues identified with the tree crash data. Discusses various findings obtained from the descriptive statistics. It also discusses hazardous regions and road stretches obtained from crash ranking matrix. It compares the output of benefit/cost analysis Roadside Safety Analysis Program. Chapter 5 summarizes conclusions of this thesis and provides recommendations for future research.

CHAPTER 2

LITERATURE REVIEW

Trees are valued as a resource along our highways, primary and secondary roads, and city streets (1). There are numerous benefits of having trees along our roadsides. Trees not only improve the aesthetic appeal of our roadsides, they also are a great asset in controlling erosion along the roadsides and providing positive air quality benefits. However, they have come under scrutiny as posing a higher risk in recent years (1). Trees located in the close proximity to the roadway can have adverse impacts such as increasing the number of injuries and fatalities that occur when vehicle leaves the roadway, decrease sight distance at curves and intersections, block important signs, obstruct drivers' vision of pedestrians and other roadway users, buildup debris in drainage areas, and pose dangerous threats during periods of bad weather such as strong winds or snow. One of the most common causes of fatal and severe injury crashes, on rural roads in particular, involves vehicles leaving the road and striking a tree and their impact severity is generally very high compared to other fixed objects (2).

Tree crashes are strongly correlated with traffic volume, roadway geometry, and overall roadside condition. For average daily traffic (ADT) categories of 1,000 vehicles per day (vpd) and below, 22 to 24 percent of fixed-object crashes involve striking trees (2). This compares to 16 percent involving tree crashes for roads with ADTs of 1,000 to 4,000 vpd, and 11 percent for ADT above 7,500 (2). The frequency of crashes per mile involving trees increases as ADT increases and depends upon distance of trees from the road; and "tree coverage" (i.e., percent of

the roadside with one or more trees) (2). The tree crash frequency per mile depends upon various factors such as roadway geometry (e.g., roadway width, roadway alignment); traffic factors (e.g., percent trucks); and driver factors (e.g., percent of drinking drivers, young drivers). A “high-crash” segment may be one in which no more than two or three tree-related crashes occur over a 5-year period, thus problematic areas are very difficult to identify (2).

The guide to management of roadside trees classifies various characteristics leading to vehicle/tree accidents into following three:

1. Driver characteristics.
2. The road design, geometrics.
3. Trees and the roadside environment.

Various driver characteristics that influence tree crashes are driver age, sex, influence of alcohol, residence of the driver, time of day, week, year, driving speed and driver’s intent. Over 60 percent of the fatalities in run-off-rod accidents are under 35 years old (1). Drivers under 20 years of age have an accident involvement six times than the average for all the drivers (1). Accidents involving males outnumber those involving females by a ratio of 2:1 (1). More than 60 percent of the drivers killed in vehicle/tree crashes had been drinking; less than 30 percent of the drivers involved in property-damage only accidents were reported to have been drinking (1). More than two-thirds of tree related collisions occur on weekends, especially Friday and Saturday nights, usually between the hours of 2:00 and 4:00am (1). Crashes are more frequent during the winter months, suggesting some correlation with longer periods of darkness and, perhaps, with snow covered or icy

roads (1). Police officers have reported “speeding” more than any other violation as the reason for a vehicle/tree crash (1).

The various road design characteristics influencing vehicle/tree crashes are the road environment, lane width, markings, medians, shoulder width, grade, curves and traffic volume. Accidents involving trees are mainly rural phenomena, occurring most frequently on rural local roads (1). Of the fatal accidents, 81.6 percent occurred on rural local roads; 70.8 percent of the injury-producing and 65.8 percent of property-damage-only (PDO) vehicle/tree accident occurred in unincorporated areas (1). Lane widths of less than 10 feet (3.1 m) the number of tree crashes is expected to increase (1). Fatal, injury and PDO accident rate is found to decrease steadily with an increase in shoulder width from 3 to 10 feet (1). Seventy seven percent of tree related accidents on curves occur on “outside” of the curves; that is, to the right of a left curve of the left of a right curve (1).

Various roadside environment characteristics that influence vehicle/tree crashes are tree size, distance of trees from road, and tree density. Fatal tree accidents are more closely associates with larger trees than are nonfatal accidents (1). For fatal tree accidents the median tree diameter at breast height (DBH) is 20 inches; in nonfatal tree accidents, the median tree diameter is 15 inches (1). Although trees involved accidents have been far from the pavement edge as 90 feet, 85 percent of the trees involved in vehicle/tree crashes were within 30 feet of the road (1).

The National Cooperative Highway Research Program (NCHRP) denotes objectives and strategies to assist in improving the situation of tree involved

crashes, specifically in the areas within the clear zone. The following chart comes from the NCHRP 500, volume 3 report that focuses on the tree issues on roadsides and specifies the recommended methods for improving safety from trees for road users.

Table-1, Objectives and Strategies for Eliminating Tree Hazards in the Roadside Environment (2)

Objectives	Strategies
Prevent Trees from Growing in Hazardous Locations	Develop, Revise, and Implement Planting Guidelines to Prevent Placing Trees in Hazardous Locations (T)[a]
	Mowing and Vegetation Control Guidelines (P)
Eliminate the Hazardous Condition and/or Reduce the Severity of the Crash	Remove Trees in Hazardous Locations (P)
	Shield Motorists from Striking Trees (P)
	Modify Roadside Clear Zone in the Vicinity of Trees (P)
	Delineate Trees in Hazardous Locations (E)
(T=tried), (E=experimental), and (Proven)	

The strategy follows the hierarchy as presented in the AASHTO Roadside Design Guide (1996):

1. Remove the obstacle or object;
2. Redesign the roadway, object, or obstacle so it can be safely traversed;
3. Relocate the object;
4. Reduce the impact severity;
5. Shield drivers from the object; and
6. Delineate the obstacle if the above alternatives are not appropriate.

Preventing trees from growing in hazardous locations reminds of an age old adage “prevention is better than the cure”. This is very simple and straight to the point but, NCHRP 500 report states that this is less simple than thought. Determining a potential hazardous location determines significant work amount of work with safety engineers, landscape architects, community representatives, and conservation groups (2). The 30-foot clear zone in all cases is not reasonable, as pointed out by AASHTO Roadside Design Guide (2). The roadside plantation and maintenance guidelines should consider vehicle speed, roadway curvature, purpose of the roadway and type of facility users (2).

Some states have defined minimum distances from the traveled way at which plants may be placed. South Carolina Department of Transportation vegetation management guidelines suggest interstate shoulders may be mowed up to 30 feet from the edge of the pavement where slopes permit. Where slopes are steep, the guidelines suggest mowing to the slope and one swath of the mower or not less than five feet on the slope. However, the guidelines strictly prohibit clearing beyond the routine mowing limits on interstates. The state of North Carolina has developed Integrated Roadside Vegetation Management (IRVM) guidelines for maintaining roadside vegetation for providing safe transportation facilities free of vegetative obstructions with clear and open sight distances. The department for years has allowed for safety recovery zone of 40 to 50 feet from the edge of roadway. Vegetation management plan of Oregon state department provides a clear zone of 30 feet from the edge of travel wherever practical.

Similarly many states have developed localized integrated vegetation management plans to comprehensively manage roadside. The Iowa Living Roadway Trust Fund defines IRVM as “a response to poor roadside management”. To ensure maximum effectiveness an IRVM program should be included in project planning stages as early as possible. The early design and planning activities of a highway design program provides a very good opportunity for vegetation managers to influence the sustainability. The NCHRP report on integrated vegetation management lists examples of Integrated Pest Management principles as below:

- Selection of grass seed species and inclusion of forbs in the erosion control seeding will have a site with a plant community having a potential to develop into self sustaining stable plant community.
- A stable plant community reduces increasing demand on the available resources
- Specifying the timing and methods of mowing new plants will influence the long-term plant populations and plant diversity that may be part of a habitat for other species.
- Prescription use of fertilizers and herbicides contributes to the integration of the methods of managing the vegetation.
- As the plant community matures under a plan developed and initiated in the project planning process, the introduction of biological control organisms may be needed to control target species of plants that may jeopardize the long-term sustainability of the plant community.

Using native plants for vegetation on the roadside may provide a practical solution to weed management, leading to reduction in pesticide applications and to less expense in labor (5, 6, and 7). Also they are well adapted to the climate and the natural enemies of the given region. Caltrans has used native wildflowers at more than 100 sites statewide (CalTrans 2003). Minnesota, Iowa, New York, and Maryland state department of transportation's encourage the use of native trees, shrubs, and wildflowers in their IRVM programs. Florida uses lot of native shrubs and forbs but not grasses. Maryland DOT works with US Department of Agricultural Plant Materials Center to produce native grasses, including big bluestem, andropogon gerardii; little bluestem, Andropogon scoparius; Indian grass, Sorghastrum nutans; switchgrass, Panicum virgatum; broomsedge, Andropogon virginicus; costal panicum and partridge pea, Chamaecrista fasciculate. Oregon uses seven major native plant species from the coast to the high desert.

For the trees located on the roadside, the first step in deciding what must be done to provide the safest facility is specifying at what size trees become potentially hazardous. The forestry industry uses tree trunk diameter as an important description of trees. The measurements should be taken at the "bumper" height which is the typical height of impact, accepted to be near two feet above the ground.

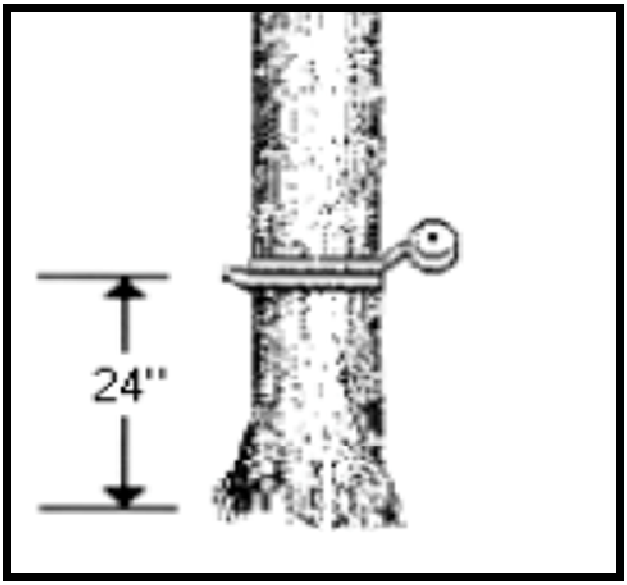

Figure-4, Measuring Tree diameter

A typical post used for sign support on the roadside has a size of four inches by four inches. Engineers therefore assume trees with a diameter of four inches are a hazard. For the purpose of efficiency and simplicity, organizations producing manuals and policies on this topic may choose to allow measuring the circumference of the tree trunk, instead of the diameter, at a height of two feet above the ground. Table-2 below suggests values used to determine if a tree is potentially hazardous to errant vehicles.

Table-2, Recommended Measurements to determine if a tree is hazardous

Measurement	Metric Units	English Units
Diameter of Tree	10 centimeters	4 inches
Circumference	32 centimeters	12.5 inches
Height to Measure	61 centimeters	24 inches

Once the hazardous size of the trees is determined, the next step is to determine whether they are within the clear zone area. To do this, the side slope of cut and fill and height of cut and fill must be known. Ditch sections must be checked for traversibility, and fill section must be checked for recoverability and traversibility. In addition, if the tree is located along a section of roadway with curvature, additional distance should be provided in relation to the extremity of the horizontal curve. If the tree is within this area, the site should be treated with one of the options mentioned by the Roadside Design Guide. Removing trees along highways having a history of tree crashes and/or removing trees with a high probability of being struck is an option. The Pennsylvania DOT has developed a table for estimating crash reduction for situations where numerous trees are present, relating the reduction to the distance of the tree line from the traveled way as shown below:

Table 3, Crash Reduction Factors for shifting the tree line (Pennsylvania DOT)

Tree Line Before Removal (Feet)	Expected Reduction in Tree Crashes (Crash Reduction Factors)										
	Tree Line After Removal (Feet)										
	6	7	8	9	10	11	12	13	14	15	20-30
4	0.3	0.42	0.49	0.55	0.6	0.63	0.69	0.7	0.72	0.73	0.77
5		0.36	0.43	0.5	0.56	0.59	0.65	0.67	0.69	0.7	0.74
6			0.27	0.36	0.43	0.48	0.55	0.57	0.6	0.62	0.67
7				0.22	0.31	0.37	0.46	0.48	0.52	0.54	0.59
8					0.22	0.29	0.39	0.42	0.45	0.48	0.55
9						0.18	0.3	0.33	0.37	0.4	0.48
10							0.22	0.25	0.3	0.33	0.42
11								0.18	0.24	0.27	0.36
12									0.11	0.15	0.25
13										0.11	0.22
14											0.17

Any tree removal program needs to target a substantial sample of road sections each year to have any effect on overall problems. Limiting the program to too few locations will not have a noticeable impact for a long time and may erode confidence in the program (2).

Providing a guardrail to shield motorists from striking trees is another strategy. However, guardrail is reported to be the fourth most frequently struck fixed object for fatal crashes in the United States (2). A 1999 study by Hunter et al. found that installing a median barrier on a freeway section significantly increased the frequency of crashes. The barrier also contributed to decrease in the number of fatal and severe injury crashes and the severity index.

Modifying roadside clear zone in the vicinity is another strategy that involves any change to the side slope or roadside clear zone designed to reduce the likelihood of tree crashes by increasing the chances that a ROR vehicle can successfully recover without striking a tree (2). This may be achieved in variety of

ways, such as flattening or grading side slopes, regarding ditch sections, adding shoulder improvements, or providing protective plantings on the roadside (2). The cost to modify the roadside is often considerably higher than tree removal and guardrail installation however, applying this strategy on specific curves or short tangent sections of roadway may help manage costs (2).

CHAPTER 3

METHODOLOGY

A multifaceted approach was taken to achieve the objectives of this thesis. The following flowchart identifies the various stages of the approach:

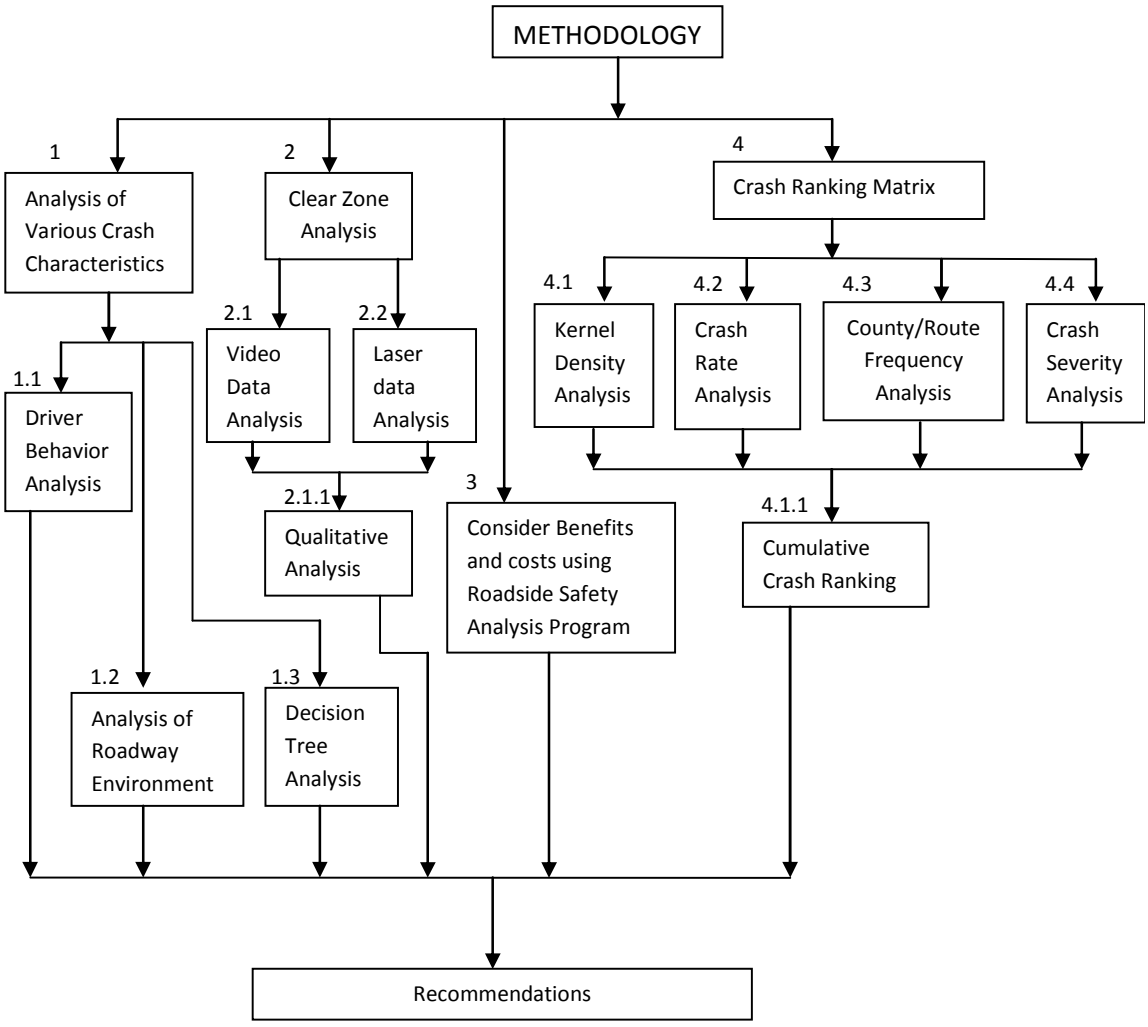

Figure-5, Various stages and steps taken to achieve thesis objectives

Data Sources:

For the current research, the following datasets were reviewed and analyzed:

- Police accident reports for a period of three years (2004-2006) obtained from the South Carolina Department of Transportation (SCDOT).
- Roadside inventory data obtained from the "Support for Elimination of Roadside Hazards" project.

The police accident reports database obtained from SCDOT for a period of three years (2004-2006) contained detailed information about crash event, location, vehicles, drivers and occupants involved. The entire crash database consists of three sub-databases of location, unit, and occupancy. The location data base included 333,051 (111,017 per year) accident cases for the period of three years. The unit database had a total of 623,738 (207,913 per year) individual cases listed. Occupancy data was available only for year 2004 and consisted a total of 198,405 individual cases. Database was incomplete and had to be updated with the missing data. A separate file of ADT data was obtained from SCDOT. Various other data such as roadway functional classification, speed limit, number of lanes, ADT were not available in crash data and had to be manually extracted from SCDOT Roadway Inventory Management System (RIMS) for each crash.

The roadside inventory data obtained from the Support for the Elimination of Roadside Hazards Project consists of the following:

- Graphical plots of roadside features obtained from the laser measurement device.

- Video based data of critical road stretches collected during site data collection.

The graphical plots of roadside objects and video data were obtained while inventorying the sites using Clemson University mobile transportation laboratory van. The van combines video-log capability with precision GPS location and a laser measurement device that allows capturing roadside features information to the nearest solid object. The laser measurement device secured in the rear side of the van would rotate 360 degrees and takes 400 measurements within one revolution at a rate of 20,000 samples per second and records distance information to the nearest object on the roadside. A custom software was used to manipulate the data obtained from the laser measurement device to display it in graphical format. A graphical plot of the laser data is as shown in the Figure-6.

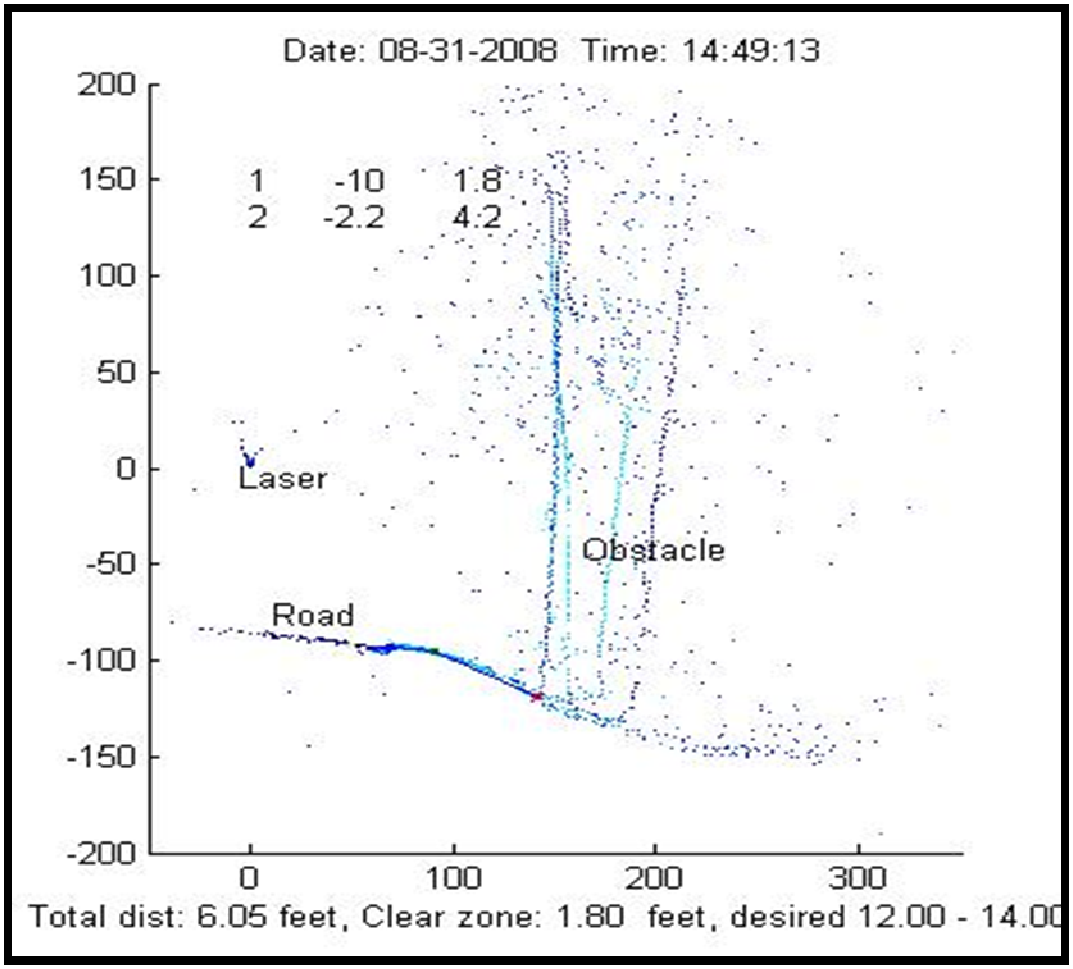

Figure-6, Graphical plot of roadside objects obtained from laser data

1. Analysis of Various Crash Characteristics:

Abundant research had been performed to identify, rank and tabulate the risk potential of many characteristics of vehicle/tree crashes. For the current study, descriptive statistics were calculated to determine any significant contribution of these crash characteristics with the tree crash. The police accident reports database obtained from SCDOT from the years 2004 to 2006 were used to compute descriptive statistics. As mentioned before the data based consisted of all kinds of crashes that occurred in the state for a period of 3 years. Thus, to select only the

tree crashes a query was performed in the MS Access database software with the condition stating to select all the crashes whose first harmful event, most harmful event, and for sequence of events (one, two, three, and four) involved hitting a tree. A total of 18,036 tree related crashes were identified in the period of 3 years. 1765 crashes included multiple vehicles colliding and resulting in running off the road and hitting a tree during the sequence of events. Thus, a total of 18,969 drivers were involved in 18036 crashes. All the cross tab queries computed in MS access have a total of 18,036 or 18, 969 for queries related to crashes and drivers respectively. As mentioned before the occupancy database was available only for the year 2004 and thus any queries related to the occupancy data such as restraint equipment used, occupant gender etc., were performed only for the respective year. Thus, year 2004 had a total of 5,954 tree related crashes and a total of 6,172 drivers were involved in the crashes. In addition to general crash data, various characteristics related to clear zone deficiency were also analyzed. A total of 51 sites were analyzed for the clear zone using the procedure described in the laser data analysis and were joined with the location and unit data base. Various cross tabs were computed in MS Access to determine the trend of various crash characteristics with tree crashes. The factors analyzed were divided into two categories as below:

1.1 Driver Behavior Analysis:

The various behavioral factors contributing to tree crashes that were analyzed in descriptive statistics are as listed below:

- Age of the driver

- Driver gender
- Influence of alcohol/drugs
- Speeding
- Ethnicity/Race of driver
- Combinations of above

1.2 Analysis of Roadway Environment:

Descriptive statistics were performed to determine any significant correlation with the various roadway and environmental characteristics. Various factors that were analyzed are as below:

- Day of the week
- Time of the day
- Light condition
- Weather condition
- Road surface condition
- Functional classification of a road
- Presence of curve
- Clear zone distance
- Slope of the embankment
- Probable Cause

1.3 Decision Tree Analysis:

In addition to descriptive statistics analysis, SPSS AnswerTree software was used to divide various data into classes to determine their influence on a variable of interest. AnswerTree is a computer based learning system which creates classification system and displays them as decision tree. The database of police accident reports were imported into the AnswerTree program. The software allows following four different statistical growing methods to classify the data:

- CHAID: Chi-Squared Automatic Interaction Detection. This method uses chi-squared statistics to identify optimal splits. The target variable can be nominal, ordinal, or continuous.
- Exhaustive CHAID: This method is a modification of CHAID that does a more thorough job of examining all possible divisions/splits for each predictor. The target variable can be nominal, ordinal, or continuous
- C&RT: Classification and Regression Trees. These methods are based on minimization of impurity measure. The target variable can be nominal, ordinal, or continuous.
- QUEST: Quick, Unbiased, Efficient Statistical Software. This method computes quickly and avoids the other methods. Biases in favor of predictors with many categories. The target variable must be nominal.

The target variables of interest were crash severity and driver age. From descriptive statistics, driver age was noted as major factor in tree related crashes, thus research team wanted to evaluate the influence of driver behavior, geometric design, and environmental conditions that contribute to the younger driver crashes

and their severity. Exhaustive CHAID was chosen as the statistical growing method for the current analysis. CR&T and QUEST generate binary trees (i.e. each split results in exactly two child nodes). Thus they were not used for the analysis because the target variables have more than two fields and thus require more than two splits to examine thoroughly. Also, the target variables (Crash Severity and Driver Age) are categorical in nature and which is not accepted by QUEST. As mentioned before, Exhaustive CHAID is similar to CHAID but performs thorough analysis thus the former was chosen over the latter.

Various predictor variables that were considered for analysis of the target variable "crash severity" are as listed below:

- Driver Age Group
- Driver Gender
- Influence of Alcohol/Drugs
- Speeding
- Roadway surface conditions
- Probable cause
- Light Condition
- Time of day
- Weather condition
- Functional Class of road

Various predictor variables that were considered to analyze target variable "driver age" are as below:

- Driver Gender

- Influence of Alcohol/Drugs
- Crash Severity
- Speeding
- Roadway Surface Conditions
- Probable cause
- Time of day
- Functional Classification of road
- Weather condition
- Driver received citation

The stopping criteria included a minimum tree depth of 3 levels and a minimum of 100 cases in the parent node and 50 cases in the child node. The analysis was run to better understand various predictive variables.

2. Clear Zone Analysis:

When assessing crashes involving trees on the roadside, it is important to understand any possible issues of clear zone deficiency. Clemson University undertook a study of fixed object crashes in state of South Carolina to determine whether clear zones are adequate based on criteria set forth in the AASHTO Roadside Design Guide, 2006.

To assess the adequacy of clear zones, the research team viewed video logs and laser measurement data simultaneously to record information about the sites (i.e. curve/straight, speed-limit, etc.) and to measure side slopes and distance to roadside obstacles (trees). A custom software was used to manipulate the data

collected by the laser measurement device (Figure-7). All the video log data, laser data and GIS data were linked to each other with a common field “time”.

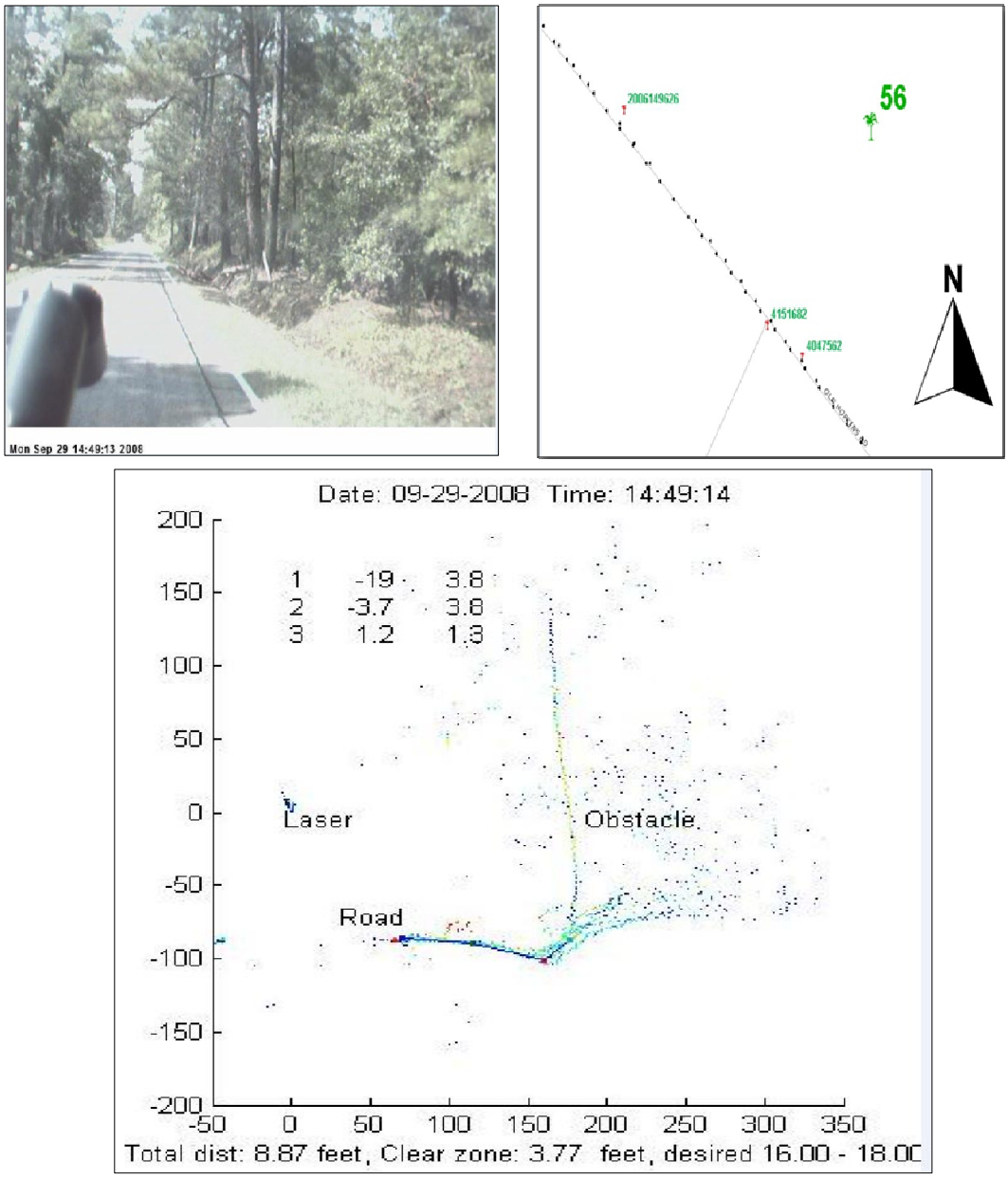

Figure-7, Video log data, GIS data and Laser data

The laser data had to be calibrated using a known horizontal or vertical surface reference such as a bridge to establish proper z-axis before marking the side slope measurements else the graphical plots would be skewed causing error in the side slopes and distance to obstacles measurements. Once calibrated, the graphical plots were used to calculate distances to roadside trees such as curves.

2.1 Video Data Analysis:

Video log files were used to navigate back and forth around the crash site (identified in GIS map) to locate hazardous trees on the roadside. Once this was achieved the time log in the video file was used to extract the laser measurement file linked to it using the software. Video log data was also used to determine the posted speed limits on the roads and make note any key features on the roadside that would increase the probability of vehicle leaving the roadway.

2.2 Laser Data Analysis:

Once the appropriate laser file was extracted and calibrated, various other details such as speed limit, AADT, and presence of roadside ditch were entered into the software. The software allows users to manually mark multiple linear segments to identify changes in slope on the roadside terrain (Figure-8). By clicking on various points where major side slope changes occur, the software calculates horizontal distances for each segment and provides the slope of individual segments. As shown in Figure-8, as the laser spins, it makes measurements to the first surface edge touched by the laser. The individual dots represent individual measurements. Thus trees, poles, and other solid items appear as linear features.

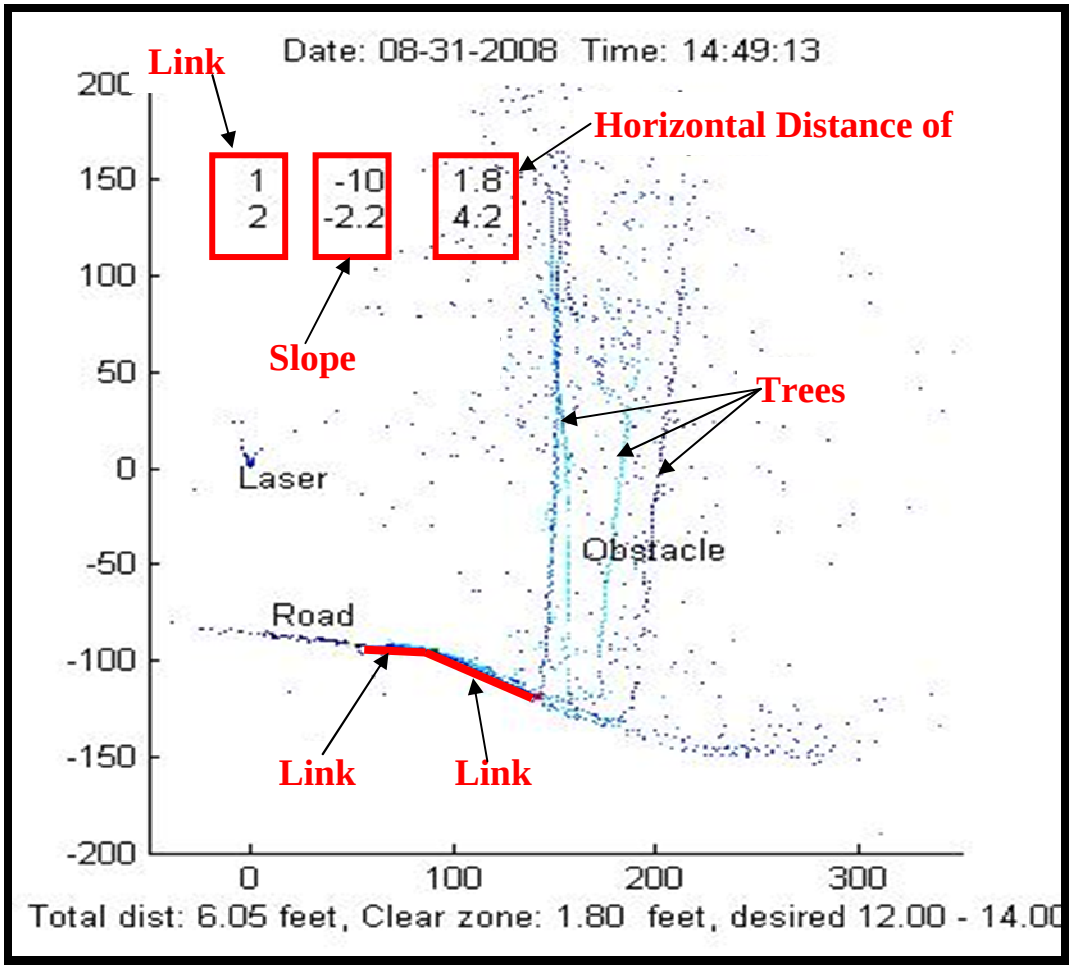

Figure-8, Roadside slope measurement

For the particular measurement shown in the Figure-8, there are 2 slope links. Starting from the edge of the travel lane (identified through changes in luminosity caused by paint markings) the links are drawn to the right until the toe of the tree is reached. The three columns on the top left corner in the Figure-8 represent link number, horizontal slope component of the side slope in _H:1V, and horizontal distance of the link. Thus, the link number 1 has a slope of 10H:1V and a horizontal distance of 1.8 feet. Similarly link 2 has a slope of 2.2H:1V and a horizontal distance of 4.2 feet. The software also automatically checks for traversable and recoverable slope status of the links and either excludes or includes

them from the total clear zone and clear zone run out area. The details of this are plotted at the bottom of the graph as shown in Figure-8. Total distance from the edge of travel lane to tree is 6.05 feet. Because link 2 is not traversable or recoverable it is removed from the clear zone calculation. Thus actual clear zone is only 1.8 feet. For the combination of ADT and posted speed the required clear zone is 12-14 feet. Thus, the site does not meet clear zone requirement. 51 sites were analyzed for the clear zone adequacy and detailed results are provided in the appendix.

2.1.1 Qualitative Analysis:

The video files and the graphical plots computed using laser data for all the 51 sites were analyzed qualitatively to determine various site conditions that would affect a crash if a vehicle ran off the roadway. The purpose was to assess whether slope or clear zone was problem. Each site was analyzed thoroughly using the video files and laser graphs and number of roadside obstacles including trees was tabulated.

3. Consider Benefits and Costs using Roadside Safety Analysis Program:

The Roadside Safety Analysis Program (RSAP) was used for assessing the benefits of clearing roadside tree and increasing the clear zone distance (Figure-9). The software runs cost effectiveness analysis procedure to determine the benefits and costs. The following assumptions were made to analyze the safety improvements:

- Fixed Segment Length
- Uniform Tree size
- Constant distance between trees
- Invariable clear zone distance
- Steady longitudinal slope

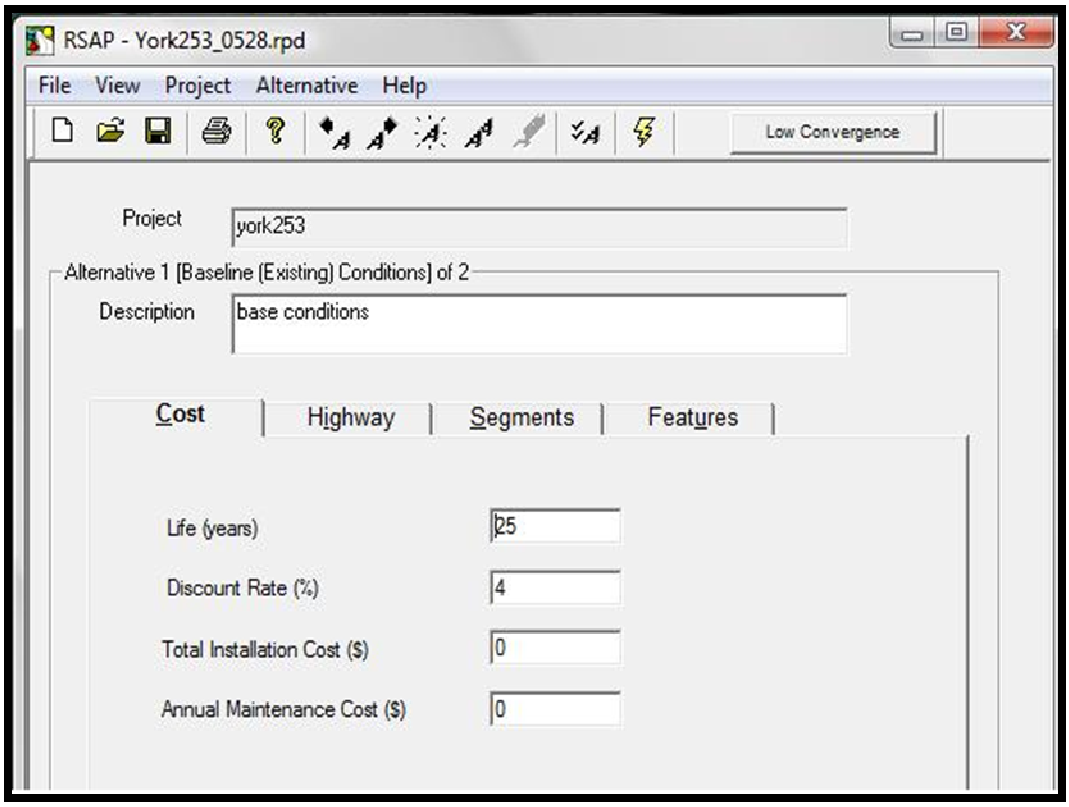

Figure-9, User interface of Roadside Safety Analysis Program

The various cost details of cutting trees and recent FHWA crash costs were obtained from SCDOT. The tree cutting cost of $12,000/acre was used and a maintenance cost of 15% was assumed. The FHWA crash costs used in the analysis were as below:

- Fatality- $5,800,000
- Injury3- $402,000
- Injury2- 80,000
- Injury1- 42,000
- PDO- $4000

Sites with similar conditions were considered to analyze benefit/cost ratios of increasing the roadside clear zone distance. All the sites had following common factors:

- Functional Classification: Secondary
- Speed Limit: 45 mph
- AADT: Less than 6000 vpd
- Number of Lanes: Two
- Lane Width: 11 feet
- Median type: No median- Undivided highway
- No curve

For these conditions, clear zone requirements were12 feet to 14 feet and actual clear zones ranged from 1.8 feet to 9.27 feet. The analysis was run for five different scenarios as listed below:

- Existing conditions
- Clear trees 7 feet from the edge of roadway
- Clear trees 14 feet from the edge of roadway
- Providing guardrail protection

The existing conditions scenario had trees 1.8 feet from the edge of roadway. Second and third scenario had trees cleared to 7 feet and 14 feet from the roadway. The last scenario included a guardrail protection installed at 4 feet from the edge of roadway. The benefit/cost ratios for each safety improvement were analyzed with respective to other improvements and tabulated in a form of matrix.

4 Crash Ranking Matrix:

A comprehensive crash ranking matrix is developed to identify hazardous sites and road stretches in the state of South Carolina. Over the past few decades, many site selection criteria have been used to identify hazardous sites. Basic site selection methods include crash rate, crash frequency, crash density, and crash severity. None of these traditional methods are perfect and have limitations such as regression-to-the-mean effect, random noise and assumption of linear relationship between crashes and exposure. Crash density biases data towards tight road network. Crash rate biases data toward short road segment and frequency biases toward high crash volume. These limitations are accounted for in some of advance ranking criteria like use of Empirical Bayes Method but complete dataset was not available. Thus, a multiple selection methods were used to rank individual crashes. The crash data for 3 years were used to complete four specific tasks including:

1. Kernel Density Analysis
2. Crash-Rate Analysis
3. County/Route-Frequency Analysis and
4. Crash Severity Analysis

Each task is described in more detail to follow. Crashes only with first harmful event of hitting a tree were considered for the analysis of which, some data had inappropriate spatial location and had to be disregarded. Thus, a total of 14,506 tree crashes were considered for evaluation. The tree crashes will be analyzed and ranked on the scale of 1 to 4 (1 being worst) for the following individual analysis:

4.1 Kernel Density Analysis:

In order to perform this task ArcView GIS software was used which allows performing advance spatial analysis. The spatial data of all the tree crashes was used to plot the crashes in Arc GIS. The kernel density function calculates the density of trees within an area around those trees. When the analysis is run a smooth curve is fitted around each point. The surface value is highest at the location of the point and diminishes with increasing distance from the point, reaching zero at the search radius distance from the point. The kernel density analysis is available under spatial analyst tools in Arc toolbox. The tree crash data was used as input features and a value of NONE was specified in the population field (if a population field setting other than NONE is used, each item's value determines number of times to count the point). A search radius of 6 miles was specified to plot the kernel density. The density at each output raster cell is calculated by adding the values of all the kernel surfaces where they overlay the raster cell center. Figure-10 shows a picture of kernel density analysis performed in Arc GIS.

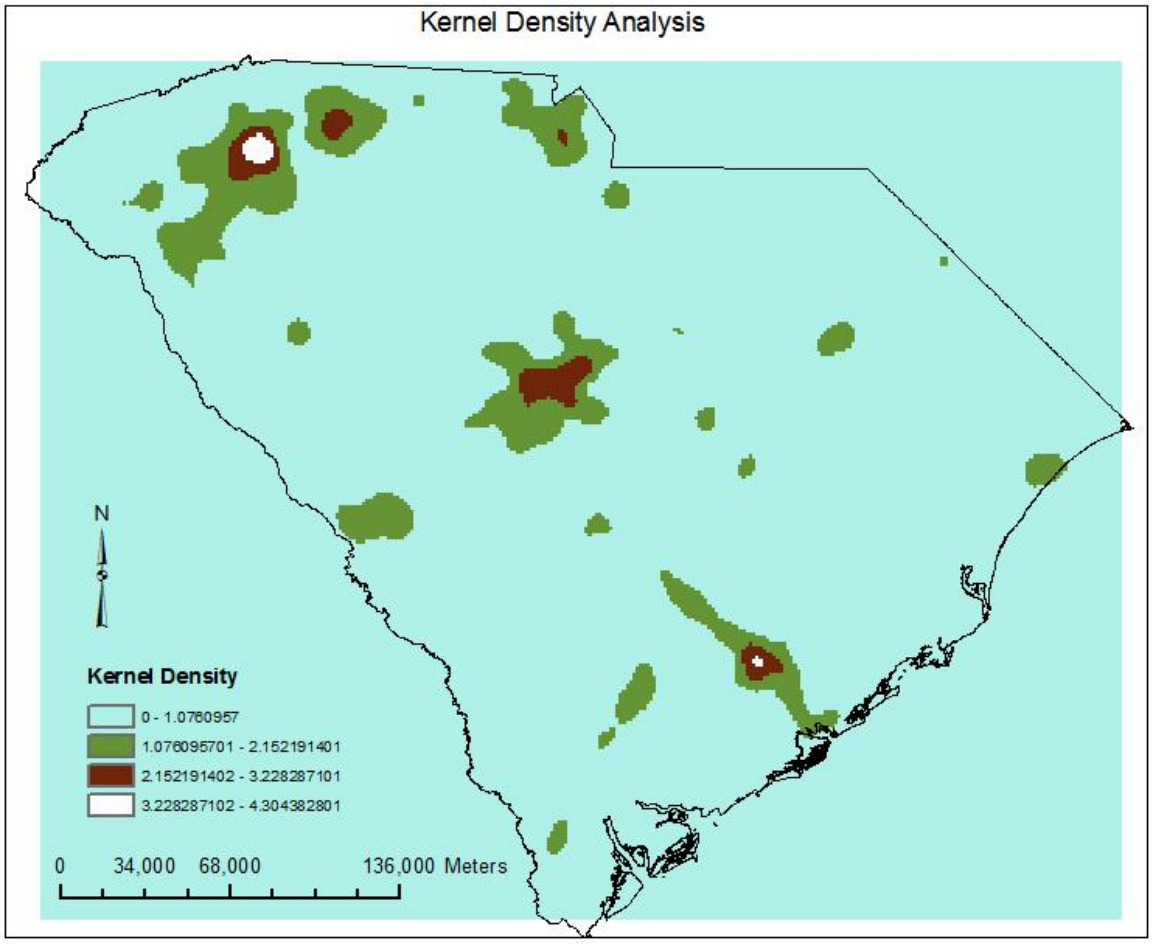

Figure-10, Kernel Density Plot in ArcView GIS software

After running the kernel density analysis the areas were categorized into 4 different regions based upon the density of crashes per unit area. The crashes in the region of high crash density were given a ranking of one and crashes in the lowest density region were given a ranking of four. All the ANOs were assigned a ranking based upon the region they fall into.

4.2 Crash Rate Analysis:

A standard measure used for ranking crashes is crash rate. Crash rate requires information on segment length, number of crashes on segment and AADT data on the segment. The number of crashes occurring on each segment of the roadway was determined using the buffer function available in the spatial analysis tab in the data analysis toolbox of ArcGIS software. Local streets were not considered in this analysis as it caused a situation where the buffers of different segments of road close to each other would overlay and the crashes falling into those buffers were double counted. Also there was not any crash pattern observed on the local roads unlike interstates or other primary and secondary roads. Thus, to reduce the error and misrepresentation of the calculated data, a total of 9,923 crashes on local streets were dropped from the analysis. A buffer of 262.46 feet (80 meter) was created around each road segment and all the crashes falling within the buffer zone were associated with the appropriate segment by performing the overlay function. The total segment length for each site was calculated as the difference between the start and end of the buffer region. The crash rate is calculated using the formula listed below:

Crash Rate=AADT*365*3*Total Segment Length/1,000,000 (Equation 1)

Where, AADT is the Average Annual Daily Traffic which is available in the SCDOT crash data. 3 is the number of years for which the crash data is available. The ratio between crash count and exposure was calculated as crash rate and is the rate for hundred million vehicle miles of travel. The calculated crash rates were sorted in descending order. Crash site rates were sorted into quartiles.

The sites with the highest quartile crash rates were ranked 1 and sites in the second quartile were ranked 2 and so on with the lowest crash rate quartile having a rank of 4. Figure-11 below shows the map of crash rate analysis performed in ArcGIS:

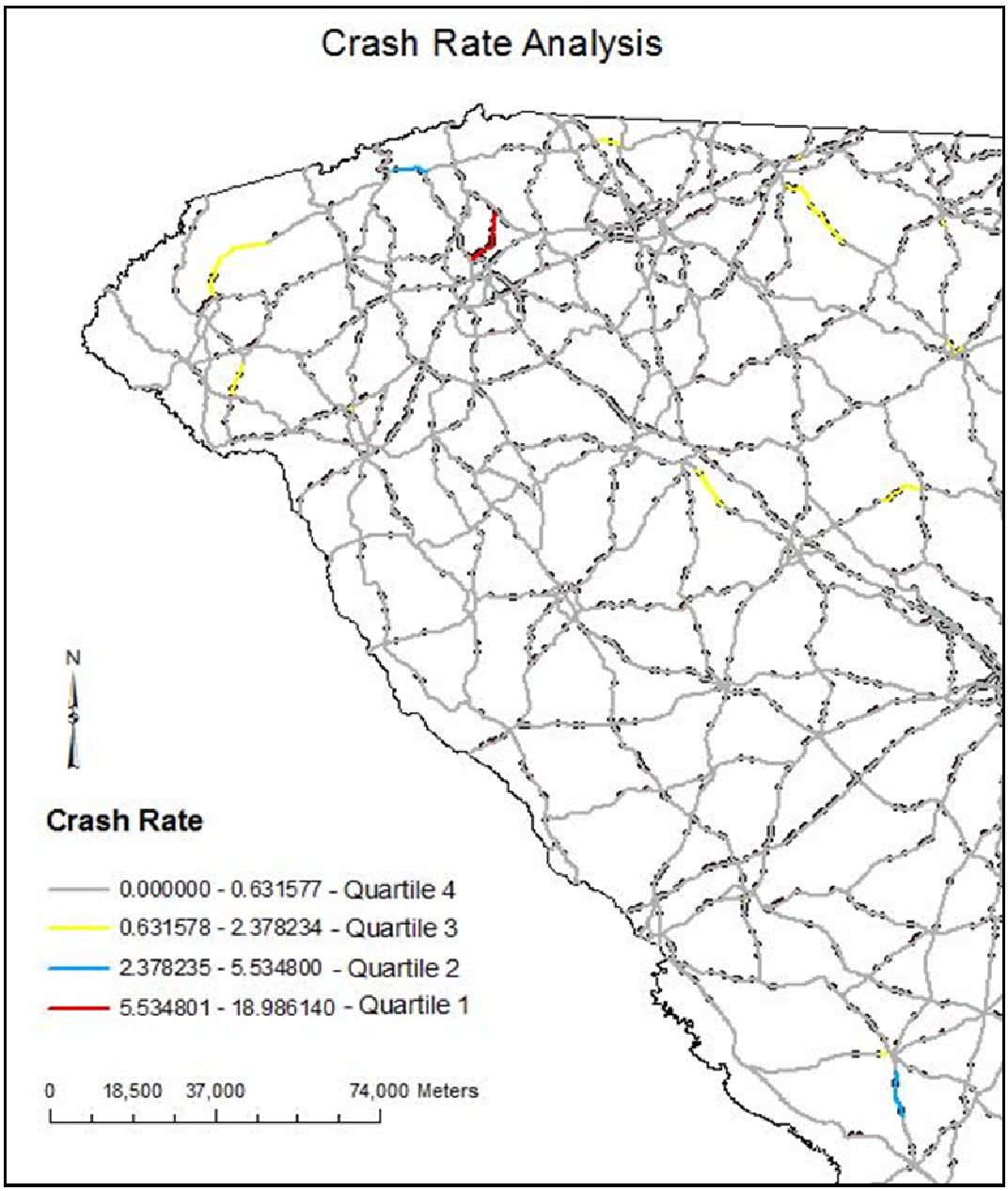

Figure-11, Crash-Rate analysis plot in ArcGIS software.

4.3 County/Route Frequency Analysis:

Another popular crash rating method is to assess frequency or total number of crashes occurring on individual road segments. For this analysis a spatial selection query was performed in ArcGIS to select all the road segments with crashes on them. A spatial join was then executed to associate all the crashes with their respective road segment identifier. The file was exported into MS Excel software. All the road segments in the county were listed in the descending order and grouped into quartiles with the routes having highest number of crashes were ranked number 1 and the routes with lowest number of crashes were ranked number 4. All the crashes that appeared on the route with highest number of crashes were assigned its ranking. After assigning ranks to all the crashes the file was then imported into ArcGIS and plotted.

4.4 Crash Severity Analysis:

The final ranking method was to rank crashes based on the severity of the crash. All the tree crashes were classified into three categories:

- Fatal crash
- Injury crash
- Property Damage Only (PDO) crash

All the crashes with one or more fatality was given the ranking of 1, crashes with one or more injuries was given a ranking of 2 and all other crashes were assigned a rank of 3.

4.1.1 Cumulative Crash Ranking:

A cumulative crash ranking was assigned to each tree crash by adding its respective rank in each of the analyses explained above. Thus a more hazardous tree site will have a low cumulative ranking and a less hazardous tree site will have a high cumulative ranking. Rankings ranged from 4 to 15 based on possible points accumulated across rankings.

CHAPTER 4

ANALYSIS AND RESULTS

The analysis of this project was done in four phases. Following are the four phases:

1. Analysis of various crash characteristics: This section will discuss various environmental and design factors influencing run off the road tree crashes as well as several behavioral problems. Discussion of decision tree model generated by AnswerTree software will attempt to explain variables contributing to crash severity and age related crashes.
2. Review roadside clear zone analysis: This section will explain the impact of having insufficient clear zone distances and steep embankment slopes. Qualitative analysis of video and laser graphs will discuss the presence of various obstacles on the roadside other than trees and importance of treating them to enhance the roadside safety.
3. Benefit/Cost analysis using RSAP program will explain the benefits of clearing roadside trees and increasing the clear zone distance.
4. Development of crash ranking matrix: Identifying regions and road segments of interest in the state by classifying tree crashes according to several traditional methods:
    a. Spatial density of tree crashes
    b. Crash rate
    c. County/route frequency

d. Crash severity

Phase 1: Analysis of Various Crash Characteristics:

The discussion of factors affecting roadside tree crashes will be divided into two sections. The first section will deal with environmental and design factors and second section will consider different behavioral factors such as speeding and driving under the influence.

Environmental and Design factors:

1. Approximately 31 percent of all the tree crashes occurred during weekends (Saturday/Sunday) (Table-4).

Table-4, Tree crashes based on day of the week

DAY OF THE WEEK	TOTAL CRASHES	% CRASHES
SUNDAY	2752	15.26
MONDAY	2268	12.57
TUESDAY	2399	13.30
WEDNESDAY	2611	14.48
THURSDAY	2554	14.16
FRIDAY	2547	14.12
SATURDAY	2905	16.11
TOTAL	18036	100.00

2. More than half of tree related crashes occurred between the hours of 6 PM and 6 AM, suggesting possible correlation between the poor visibility (dark) conditions and crashes (Table-5, 6).

Table-5, Tree crashes based on time of the day

TIME PERIOD	TOTAL CRASHES	% CRASHES
0AM-6AM	4617	25.60
12PM-6PM	4507	24.99
6AM-12PM	3749	20.79
6PM-12AM	5163	28.63
TOTAL	18036	100

Table-6, Tree related crashes based on lighting conditions

ALC-LIGHT CONDITION	TOTAL CRASHES	% CRASHES
DARK	9012	49.97
DAYLIGHT	8209	45.51
DAWN	476	2.64
DUSK	339	1.88
TOTAL	18036	100

3. Drinking and driving during poor visibility/dark conditions is considered to be a common ingredient for vehicle/tree crashes. Of all the tree related crashes, only 5.7% involved positive DUI (Driving Under the Influence) test results. Therefore, tree crashes occur for many reasons other than DUI. Of those that did involve, approximately 68 percent were driving during dark conditions (Table-7).

Table-7, DUI reported tree crashes based on visibility

ALC-LIGHT CONDITION	DUI RESULTS		
	TESTS GIVEN	POSITIVE	% POSITIVE
DARK	1431	709	67.98
DAWN	43	24	2.30
DAYLIGHT	506	292	28.00
DUSK	42	18	1.73
TOTAL	2022	1043	100

4. Weather was considered to have an impact on the run of the road tree related crashes. Approximately 70 percent of all the crashes occurred during clear weather conditions. However, the remaining 30 percent of crashes had influences of bad weather. Rain, sleet, snow and fog contributed approximately 20 percent and cloudy weather condition contributed to 11 percent of tree related crashes (Table-8).

Table-8, Tree related crashes based on weather conditions.

WCC-WEATHER CONDITIONS	TOTAL CRASHES	% CRASHES
CLEAR (NO ADVERSE CONDITIONS)	12429	68.91
RAIN, SLEET, SNOW, FOG	3686	20.44
CLOUDY	1921	10.65
TOTAL	18036	100.00

5. About 75 percent of accidents occurred on a dry roads indicating pavement surface condition is not a predominant factor for run off the road tree crashes. However, it is easy to lose control of an errant vehicle on wet and

slippery roads. About 23 percent accidents occurred on wet road surface conditions (Table-9).

Table-9, Tree related crashes based on road surface conditions.

RSC-ROAD SURFACE CONDITON	TOTAL CRASHES	% CRASHES
DRY	13457	74.61
WET/SLIPPERY	4458	24.72
OTHER	56	0.31
UNKNOWN	65	0.36
TOTAL	18036	100.00

6. Approximately 72 percent of tree-related crashes occurred on straight road sections, while 28% accidents occurred on curved sections of roadway (Table-10).

Table-10, Location of tree crash

CRASH LOCATION (2004 ONLY)	TOTAL CRASHES	% CRASHES
STRAIGHT	4269	71.70
CURVE	1685	28.30
TOTAL	5954	100.00

7. Of all the crashes, 28 percent occurred on a curve of which, 24% accidents occurred during wet/slippery surface conditions. Table-11 below represents the data for crashes based on road surface condition evenly distributed between curve and straight sections (Note: Data available only for year 2004).

Table-11, Tree related crashes based on road surface condition and presence of curve.

RSC- ROAD SURFACE CONDITION	TOTAL CRASHES	CRASHES ON CURVES	% CRASHES	% CRASHES ON CURVES
DRY	4371	1265	73.41	75.07
WET/SLIPPERY	1534	405	25.76	24.04
OTHER	24	9	0.40	0.53
UNKNOWN	25	6	0.42	0.36
TOTAL	5954	1685	100	100

8. The functional classification of the road and various physical features of the road have an influence on vehicle leaving off the roadway. About 48 percent of crashes occurred on secondary roads indicating correlation of lesser standard roads with run off the road tree accidents (Table-12)

Table-12, Tree related crashes based on functional classification of the road

RCT-FUNCTIONAL CLASS	TOTAL CRASHES	% CRASHES
INTERSTATE	2099	11.64
US PRIMARY	2038	11.30
SC PRIMARY	2713	15.04
SECONDARY	8658	48.00
COUNTY	2525	14.00
OTHER	3	0.02
TOTAL	18036	100.00

9. Of all the crashes 90% were single vehicle run off the road crashes (Table-13)

Table-13, Single vehicle/Multi-vehicle tree crashes

CRASH TYPE	TOTAL CRASHES	% CRASHES
MULTI-VEHICLE CRASH	1765	9.79
SINGLE-VEHICLE CRASH	16271	90.21
TOTAL	18036	100

Behavioral factors:

1. Of all drivers involved in tree-related crashes, male drivers have a higher probability of running of the road and hitting a tree than females. The current analysis revealed that tree related accidents involving males outnumbered those involving females by a ratio of nearly 2 to 1 (60% male drivers against 31% female drivers) (Table-14)

Table-14, Tree crashes based on driver gender

DRIVER GENDER	TOTAL DRIVERS	% DRIVERS
FEMALE	5882	31.01
MALE	11380	59.99
UNKNOWN	1707	9.00
TOTAL	18969	100.00

2. The analysis also revealed that more than 2 out of every 3 roadside tree accident involved younger driver. Over 70 percent of run off the road tree crashes involved drivers less than 35 years of age. Drivers under 25 years of age had accident involvement nearly four times higher than the average for

all drivers. The risk of having single vehicle runoff the road tree accident decreases with age (Table 15).

Table-15, Age related tree crashes

DRIVER AGE	TOTAL DRIVERS	% DRIVERS	% LICENCED DRIVERS IN POPULATION IN 200 FOR SC
0-14	537	2.98	33.21
15-24	6518	36.14	
25-34	3618	20.06	
35-44	2525	14.00	52.36
45-54	1729	9.59	
55-64	965	5.35	
65-74	472	2.62	13.42
75+	240	1.33	
UNKNOWN	1432	7.94	
TOTAL	18036	100	

3. Vehicle speed is often associated with run-off the road crashes and was found as an influencing factor for vehicle/tree crashes. Current analysis revealed nearly 45 percent of tree crashes were due to driving too fast for the conditions or exceeding speed limit. About 12% of the crashes involved vehicle going out of control due to influence of alcohol/drugs and considered to be second most probable cause for vehicle/tree accidents. Drivers involved in tree crashes commonly attribute losing control of their vehicle in attempts to avoid objects or animals. About 5% of crashes were due to avoiding an animal on the road (Table-16). The top five probable causes make up 69.04% of the total tree related crashes.

Table-16, Probable causes for tree related crashes

PRC-PROBABLE CAUSE	TOTAL CRASHES	RANK	% CRASHES
PRC-Driver-Driving Too Fast for Conditions	7550	1	41.86
Driver-Under the Influence	2120	2	11.75
Driver-Ran Off Road	979	3	5.43
Environmental-Animal in Road	943	4	5.23
Driver-Distracted/Inattention	861	5	4.77
Driver-Fatigued/Asleep	608	6	3.37
Driver Exceeded Authorized Speed Limit	531	7	2.94
Driver-Unknown	516	8	2.86
Driver-Made an Improper Turn	439	9	2.43
Driver-Medical Related	404	10	2.24
TOTAL	14951	55	82.90

4. Over 60% of tree related crashes involve younger drivers. The ratio of the percentage of licensed younger drivers involved in tree related accidents to the percentage of licensed younger drivers in South Carolina was nearly 2: 1 (Table-17). Middle and older aged drivers were underrepresented in the tree related crashes. This may be indication of lack of experience with driving. Younger drivers were also more inclined to the speed and take part in other risky activities.

Table-17, Percent of Drivers involved in tree crashes vs. licensed drivers in state.

AGE GROUP	DRIVERS IN TREE CRASHES	% DRIVERS IN TREE CRASHES	% LICENCED DRIVERS IN POPULATION IN 2000 FOR SC
YOUNG	10980	57.88	33.21
MIDDLE	5352	28.21	52.36
OLD	725	3.82	13.42
UNKNOWN	1912	10.08	-
TOTAL	18969	100	100

5. Most drivers do have gender and age attributes. Of all the drivers involved in tree crashes approximately 45% were related to speed, of those, nearly two-thirds were male drivers (Table-18) and about three-fourths were younger drivers (below 35 years of age) (Table-19). The attribute of speeding related crashes decreased with increase in the driver age.

Table-18, Tree crashes based on gender and speed

DRIVER GENDER	TOTAL DRIVERS	DRIVERS NOT-SPEEDING	DRIVERS SPEEDING	% DRIVERS SPEEDING
FEMALE	5882	4006	1876	24.49
MALE	11380	6383	4997	65.23
UNKNOWN	1707	919	788	10.29
TOTAL	18969	11308	7661	100.00
% DRIVERS	100	59.61	40.39	

Table-19, Tree crashes based on speed

DRIVER AGE	TOTAL DRIVERS	DRIVERS NOT-SPEEDING	DRIVERS SPEEDING	% DRIVERS SPEEDING
0-14	516	421	95	1.24
15-24	6734	3504	3230	42.16
25-34	3730	2151	1579	20.61
35-44	2595	1671	924	12.06
45-54	1776	1244	532	6.94
55-64	981	749	232	3.03
65-74	482	386	96	1.25
75+	243	197	46	0.60
Unknown	1912	985	927	12.10
TOTAL	18969	11308	7661	100

6. Tree related crashes do not have any strong trends associated with driver ethnicity. As shown in Table-20, driver involvement in the tree-related crashes is nearly proportional to the driver population in the state.

Table-20, Tree crashes based on driver race/ethnicity

DRAC-DRIVER RACE	TOTAL DRIVERS	% DRIVER CRASHES	% SC POPULATION (2008)
ASIAN/PACIFIC ISLANDER	47	0.25	1.2
AFRICAN AMERICAN	5204	27.43	28.5
ALASKAN NATIVE OR AMERICAN INDIAN	17	0.09	0.4
CAUCASIAN	11135	58.70	65.2
OTHER	81	0.43	0.1
UNKNOWN	1717	9.05	0.5
TOTAL	18969	100	100

7. DUI related tree crashes involving males outnumbered those involving females by a ratio of 4:1. Of these crashes about 80% of male drivers driving under the influence of alcohol/drugs where as only 20 percent females were under the influence (Table-21). Younger drivers (below 35 years) represented approximately 59% of the cases involving DUI related tree crashes (Table-22). The unknown column in Table-21 includes test results that were unusable and test results that were pending.

Table-21, Driver Gender based DUI tree crashes

DRIVER GENDER	TOTAL DRIVERS	TEST NOT GIVEN	DUI RESULTS			
			UNKNOWN	GIVEN-KNOWN RESULTS	POSITIVE	% POSITIVE
FEMALE	5882	5470	226	186	206	19.38
MALE	11380	9737	853	790	856	80.53
UNK	1707	1705	1	1	1	0.09
TOTAL	18969	16912	1080	977	1063	100

Table-22, Age based DUI related tree crashes

DRIVER AGE	TOTAL DRIVERS	TEST NOT GIVEN	DUI RESULTS			
			UNKNOWN	GIVEN-KNOWN RESULTS	POSITIVE	% POSITIVE
0-14	516	508	3	5	5	0.47
15-24	6734	6086	324	324	353	33.21
25-34	3730	3198	287	245	267	25.12
35-44	2595	2171	241	183	197	18.53
45-54	1776	1497	153	126	145	13.64
55-64	981	884	49	48	50	4.70
65-74	482	442	13	27	25	2.35
75+	243	229	2	12	13	1.22
Unknown	1912	1897	8	7	8	0.75
TOTAL	18969	16912	1080	977	1063	100

8. Majority of the data for driving under the influence of alcohol was not available. Of 18969 drivers, 16938 were not suspected of DUI (Table-23). Of all the drivers tested positive nearly 60 percent younger drivers were reported for consumption of alcohol.

Table-23, Alcohol test given based on the driver age

DRIVER AGE	TOTAL DRIVERS	NOT TESTED	ALCOHOL TEST RESULTS			
			REFUSED	UNKNOWN	POSITIVE	%POSITIVE
0-14	516	509	0	2	5	0.48
15-24	6734	6091	91	229	345	33.30
25-34	3730	3205	119	162	263	25.39
35-44	2595	2176	113	123	192	18.53
45-54	1776	1505	65	83	136	13.13
55-64	981	884	20	29	49	4.73
65-74	482	442	7	6	25	2.41
75+	243	229	0	2	13	1.25
Unknown	1912	1897	3	5	8	0.77
TOTAL	18969	16938	418	641	1036	100.00

9. Out of 18969 drivers, only 192 (1.01%) were suspected for drug consumption and 404 (2.13%) were asked to take drug tests. Marijuana and cocaine were the most popularly consumed. Again, younger drivers reported to be tested positive more than any other age group. The details of drug test given and its results are tabulated in Table-24

Table-24, Drug test details based on the driver age

DRIVER AGE	TOTAL DRIVERS	NOT TESTED	DRUG TEST RESULTS								
			REFUSED	UNKNOWN	AMPHETAMINES	COCAINE	MARIJUANA	OPIATES	OTHER	+VE	%+VE
0-14	516	514	0	2	0	0	0	0	0	0	0
15-24	6734	6551	13	123	0	8	33	0	15	56	29.17
25-34	3730	3574	10	99	2	15	16	2	16	51	26.56
35-44	2595	2475	16	66	3	14	9	3	14	43	22.40
45-54	1776	1697	8	48	2	13	3	4	6	28	14.58
55-64	981	969	1	8	0	1	0	0	3	4	2.08
65-74	482	472	1	5	0	1	1	0	2	4	2.08
75+	243	240	0	0	0	0	1	0	2	3	1.56
Unk	1912	1905	0	4	0	1	1	0	1	3	1.56
TOTAL	18969	18397	49	355	7	53	64	9	59	192	100
% DRIVERS	100	96.98	0.26	1.87	0.04	0.28	0.34	0.05	0.31	1.01	0.53

10. Major factors that correlated with increased severity of tree related crashes in South Carolina included driver age, speeding and influence of alcohol/drugs. While DUI was involved in only 5.6% of all tree crashes, about two-thirds (65.63%) of tree-related fatalities involved drivers under the influence of alcohol/drugs. As well speeding was involved in 45% of all tree crashes, but more than two-third (68.62%) drivers in the fatal crashes were reported to be speeding. Younger drivers comprised largest number of fatalities over other age groups. 53 percent of fatal tree crashes involved drivers less than 35 years of age (Table-25). Of those, 34.38 percent were driving under the influence of alcohol/drugs (Table-26), 40 percent were speeding (Table-27) and about 28 percent were both speeding and under the influence of alcohol/drugs (Table-28).

Table-25, Severity of tree related crash based on age group

DRIVER AGE	TOTAL DRIVERS	FATAL	INJURY	PDO	% FATALITIES
0-14	516	4	195	317	0.55
15-24	6734	218	3036	3480	29.74
25-34	3730	168	1667	1895	22.92
35-44	2595	131	1129	1335	17.87
45-54	1776	99	772	905	13.51
55-64	981	51	449	481	6.96
65-74	482	29	196	257	3.96
75+	243	21	117	105	2.86
Unknown	1912	12	402	1498	1.64
TOTAL	18969	733	7963	10273	100
% DRIVERS	100	3.86	41.98	54.16	

Table-26, Tree crash fatalities comparing driver age and influence of alcohol/drugs

DRIVER AGE	DUI TEST RESULTS	TOTAL DRIVERS	FATALITIES	% FATAL
0-14	Not Tested/Negative	511	2	0.27
	Positive	5	2	0.27
15-24	Not Tested/Negative	6381	78	10.64
	Positive	353	140	19.10
25-34	Not Tested/Negative	3463	58	7.91
	Positive	267	110	15.01
35-44	Not Tested/Negative	2398	41	5.59
	Positive	197	90	12.28
45-54	Not Tested/Negative	1631	29	3.96
	Positive	145	70	9.55
55-64	Not Tested/Negative	931	19	2.59
	Positive	50	32	4.37
65-74	Not Tested/Negative	457	9	1.23
	Positive	25	20	2.73
75+	Not Tested/Negative	230	9	1.23
	Positive	13	12	1.64
Unknown	Not Tested/Negative	1904	7	0.95
	Positive	8	5	0.68
TOTAL		18969	733	100

Table-27, Tree crash fatalities comparing driver age and speeding

DRIVER AGE	SPEEDING RESULTS	TOTAL DRIVERS	FATALITIES	% FATALITIES
0-14	NOT SPEEDING	421	4	0.55
	SPEEDING	95	0	0.00
15-24	NOT SPEEDING	3504	44	6.00
	SPEEDING	3230	174	23.74
25-34	NOT SPEEDING	2151	47	6.41
	SPEEDING	1579	121	16.51
35-44	NOT SPEEDING	1671	43	5.87
	SPEEDING	924	88	12.01
45-54	NOT SPEEDING	1244	37	5.05
	SPEEDING	532	62	8.46
55-64	NOT SPEEDING	749	24	3.27
	SPEEDING	232	27	3.68
65-74	NOT SPEEDING	386	13	1.77
	SPEEDING	96	16	2.18
75+	NOT SPEEDING	197	11	1.50
	SPEEDING	46	10	1.36
Unknown	NOT SPEEDING	985	7	0.95
	SPEEDING	927	5	0.68
TOTAL		18969	733	100

Table-28, Tree crash fatalities comparing driver age, speeding and influence of alcohol/drugs

DRIVER AGE	DUI TEST RESULTS	SPEEDING	TOTAL DRIVERS	FATALITIES	% FATALITIES
0-14	Not Tested/Negative	NOT SPEEDING	418	2	0.27
		SPEEDING	93		0.00
	Positive	NOT SPEEDING	3	2	0.27
	Positive	SPEEDING	2		0.00
15-24	Not Tested/Negative	NOT SPEEDING	3404	17	2.32
		SPEEDING	2977	61	8.32
	Positive	NOT SPEEDING	100	27	3.68
	Positive	SPEEDING	253	113	15.42
25-34	Not Tested/Negative	NOT SPEEDING	2067	27	3.68
		SPEEDING	1396	31	4.23
	Positive	NOT SPEEDING	84	20	2.73
	Positive	SPEEDING	183	90	12.28
35-44	Not Tested/Negative	NOT SPEEDING	1594	18	2.46
		SPEEDING	804	23	3.14
	Positive	NOT SPEEDING	77	25	3.41
	Positive	SPEEDING	120	65	8.87
45-54	Not Tested/Negative	NOT SPEEDING	1184	14	1.91
		SPEEDING	447	15	2.05
	Positive	NOT SPEEDING	60	23	3.14
	Positive	SPEEDING	85	47	6.41

Table-28, Tree crash fatalities comparing driver age, speeding and influence of alcohol/drugs (Continued)

55-64	Not Tested/Negative	NOT SPEEDING	724	11	1.50
		SPEEDING	207	8	1.09
	Positive	NOT SPEEDING	25	13	1.77
	Positive	SPEEDING	25	19	2.59
65-74	Not Tested/Negative	NOT SPEEDING	373	5	0.68
		SPEEDING	84	4	0.55
	Positive	NOT SPEEDING	13	8	1.09
	Positive	SPEEDING	12	12	1.64
75+	Not Tested/Negative	NOT SPEEDING	191	5	0.68
		SPEEDING	39	4	0.55
	Positive	NOT SPEEDING	6	6	0.82
	Positive	SPEEDING	7	6	0.82
Unknown	Not Tested/Negative	NOT SPEEDING	982	6	0.82
		SPEEDING	922	1	0.14
	Positive	NOT SPEEDING	3	1	0.14
	Positive	SPEEDING	5	4	0.55
TOTAL			18969	733	100

11. About 18 percent of drivers were reported not to be wearing seat belts during tree related crashes. 69 percent of drivers were wearing shoulder and lap belt when involved in tree related crashes (Table-29) (Note: Restraint equipment used data was available only for the year 2004).

Table-29, Restraint equipment used during a tree crash

REU-RESTRAINT EQUIPMENT USED (2004 ONLY)	TOTAL DRIVERS	% DRIVERS
None Used	**1123**	18.20
Shoulder Belt	29	0.47
Lap Belt Only	26	0.42
Shoulder & Lap Belt	4231	68.55
Child Seat	1	0.02
Helmet	9	0.15
Other	1	0.02
Unknown	752	12.18
TOTAL	6172	100

(Note: Data only available for 2004)

12. The majority of drivers who received citations were reported to be younger drivers. Drivers between the age group of 15 years and 24 years received the highest number of citations over any other age group (Table-30). Male drivers receiving citations outnumbered female drivers by a ratio more than 3:1 (Table-31).

Table-30, Citation received based on driver age.

DRIVER AGE	TOTAL DRIVERS	CITATIONS RECEIVED		
		NO	YES	% YES
0-14	516	489	27	1.27
15-24	6734	5827	907	42.52
25-34	3730	3165	565	26.49
35-44	2595	2252	343	16.08
45-54	1776	1590	186	8.72
55-64	981	926	55	2.58
65-74	482	465	17	0.80
75+	243	236	7	0.33
Unknown	1912	1886	26	1.22
TOTAL	18969	16836	2133	100

Table-31, Citation received based on driver gender

DRIVER GENDER	TOTAL DRIVERS	CITATION RECEIVED		
		NO	YES	% YES
FEMALE	5882	5396	486	22.78
MALE	11380	9738	1642	76.98
UNKNOWN	1707	1702	5	0.23
TOTAL	18969	16836	2133	100

These descriptive statistics have uncovered several interesting patterns associated with tree-related crashes. The involvement of younger drivers is staggering and should be further addressed. Reducing crashes involving drivers under the age of 35 could save countless lives. Young drivers have been shown to have issues negotiating curve sections

of roadway. Advance training education could potentially impact these behaviors by increasing experience required to obtain license.

Discussion of decision tree model generated by AnswerTree software:

AnswerTree is a computer based learning system which creates classification system and displays them as decision tree. Separate decision tree models were generated to determine the factors contributing to the severity of the crashes and trends affecting age related tree accidents. These will be discussed in two sections (Refer to appendix for full decision tree models).

Crash severity:

The root node of crash severity was initially split based on DUI test results as positive and negative. All the positive DUI results were split further based on the variable "driver citation". And all the drivers who did not receive citation were categorized based on the factor of "speeding".

All the negative DUI results were split based on the driver gender as male, female and unknown. Male and female were further categorized based on "speeding". The unknown gender was split based on the functional classification of the road.

Following were some of the interesting observations made from the tree:

1. The severity of crashes is correlated with the DUI cases. The number of fatalities increased with the influence of alcohol/drugs. According to the tree, 45.52 percent of drivers involved in tree crashes were under the influence of alcohol/drugs..
2. 63.62 percent of drivers involved in tree crashes were speeding under the influence of alcohol.

Decision tree based on driver age:

The root node of driver age was initially split based on driver gender as male, female and unknown. Male drivers were further categorized based on the variable "Speeding". All the speeding male drivers were divided based on the severity of the crash as fatal, injury and PDO crashes. All the non-speeding male drivers were further categorized on driver citation. Female drivers were split based on the time of the day (6pm-12am, 12am-6am, 6am-12pm and 12pm-6pm)

Following were some of the interesting observations made from the tree:

1. Younger drivers accounted for 67.12 percent of all tree related crashes. Speeding was more associated with male drivers than female. 74 percent of young male drivers involved in a tree related crashes were speeding, 60% of which were fatal crashes.
2. 73.58 percent of female drivers involved in tree crashes were driving during poor visibility or dark conditions.

Phase 2: Clear zone data analysis:

Roadside clear zone distance was analyzed for 51 tree sites using the laser graphs and video data collected during a site inventory. The number of crashes increased with decreasing clear zone distance. Severity of the tree crashes also increased when the distance between the edge of the road and nearest tree obstacle decreased. Following were some of the statistics:

1. Of 51 sites analyzed 3 sites met minimum clear zone requirement and 48 sites did not meet (Table-32). All of the 11 fatal crashes occurred on the sites which did

not have minimum clear zone distance (Table-33). The number of fatalities increased with decreased in the distance between the edge of road and nearest roadside tree. Of 11 fatalities 9 occurred on the sites which had a clear zone deficiency of more than 12 feet (Table-34).

Table-32, Tree crashes based on Clear zone status

CLEARZONE STATUS	TOTAL CRASHES	% CRASHES
Minimum Clear zone Met	3	5.88
Minimum Clear zone Not Met	48	94.12
TOTAL	51	100

Table-33, Tree crashes comparing clear zone status and crash severity

CLEARZONE STATUS	TOTAL CRASHES	FATAL	INJURY	PDO	TOTAL
Minimum Clear zone Met	3	0	1	2	3
Minimum Clear zone Not Met	48	11	14	23	48
TOTAL	51	11	15	25	51
% CRASHES	100	21.57	29.41	49.02	100

Table-34, Tree crashes comparing clear zone deficiency and crash severity

CLEARZONE DEFICIENCY RANGE	TOTAL CRASHES	FATAL	INJURY	PDO	% CRASHES	% FATAL
0'-4'	4	0	2	2	7.84	0
4'-8'	14	1	4	9	27.45	9.09
8'-12'	15	1	5	9	29.41	9.09
12'+	18	9	4	5	35.29	81.82
TOTAL	51	11	15	25	100	100

2. Among 51 crashes analyzed, 14 occurred on a critical slope (i.e. slope steeper than 1H: 3V), 6 occurred on slopes that were traversable but not recoverable (i.e. slopes between 1H: 4V to 1H: 3V) and 31 occurred on slopes that were traversable and recoverable (i.e. flatter than 1H: 4V) (Table-35). Of 11 fatal crashes 3 occurred on critical slopes, 1 occurred on traversable but non-recoverable slopes and 7 crashes occurred on traversable and recoverable slopes (Table-36). When slopes are traversable and recoverable, only the distance from roadway edge to tree line can impact the possibility of tree crashes.

Table-35, Tree crashes based on slope category

SLOPE CATEGORY	TOTAL CRASHES	% CRASHES
Critical	14	27.45
Traversable And Recoverable	31	60.78
Traversable But Non-Recoverable	6	11.76
TOTAL	51	100

Table-36, Tree crashes comparing slope category and crash severity

SLOPE CATEGORY	TOTAL CRASHES	FATAL	INJURY	PDO
Critical	14	3	4	7
Traversable And Recoverable	31	7	10	14
Traversable But Non-Recoverable	6	1	1	4
TOTAL	51	11	15	25

3. Comparison of embankment slope and clear zone distance revealed that majority of crashes occurred on sites where minimum clear zone distance was not available. 14 out of 51 crashes occurred on critical slope which did not meet minimum clear zone distance (Table-37)

Table-37, Influence of embankment slope and clear zone distance on crash severity

SLOPE CATEGORY	CLEARZONE STATUS	TOTAL	FATAL	INJURY	PDO	% CRASHES
Critical	Minimum Clear zone Not Met	14	3	4	7	27.45
Traversable And Recoverable	Minimum Clear zone Met	3	0	1	2	5.88
	Minimum Clear zone Not Met	28	7	9	12	54.9
Traversable But Non-Recoverable	Minimum Clear zone Not Met	6	1	1	4	11.76
TOTAL		51	11	15	25	100

Qualitative Analysis of video and laser graphs:

The analysis of 51 tree crash sites revealed that, 35 crash sites had more than one roadside obstacle (3 sites with 4 obstacles, 7 sites with 3 obstacles, 25 sites with 2 obstacles and 16 sites with only 1 obstacle). Obstacles other than trees were observed at the sites which included ditches, mailboxes, culverts, poles and traffic sign posts. Figure-13 below shows a number of obstacles observed other than trees on a site with accident ID 4006214.

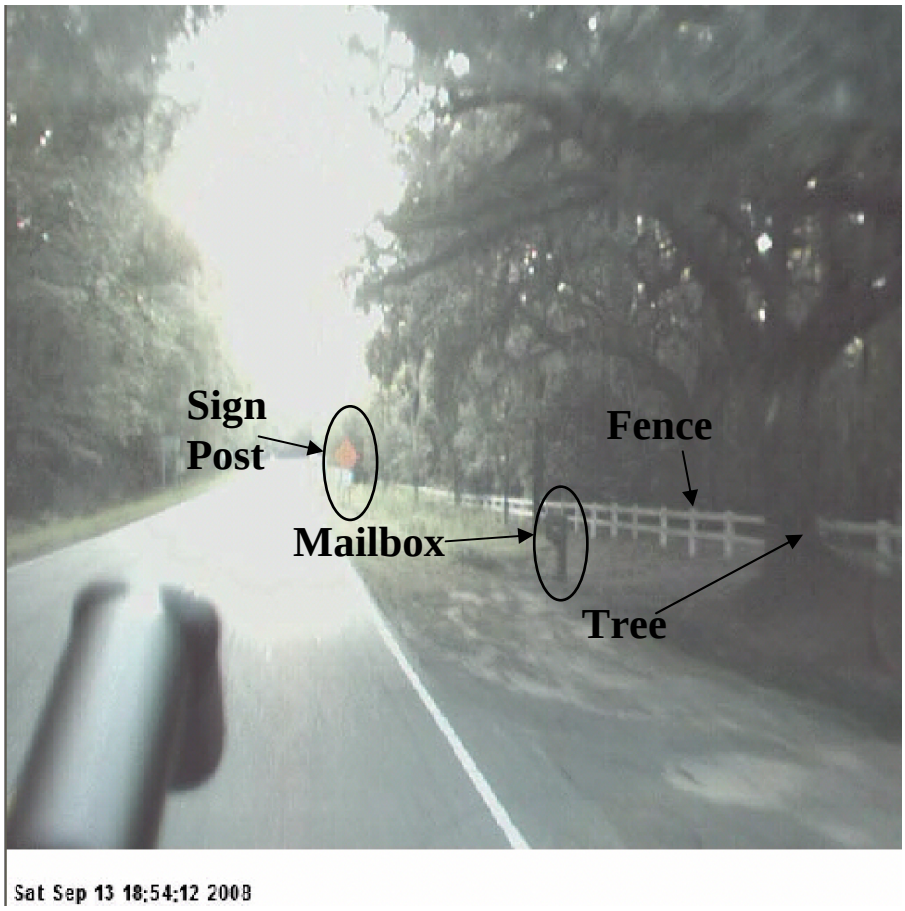

Figure-12, Obstacles other than trees on the roadside.

Ten sites were observed to have mature trees on the roadside, 14 crash sites included mature trees grown on the toe of the embankment and 14 sites had a tree line encroachment in the ditches.

The quantitative analysis revealed that obstacles other than trees exist on the roadside which may be hazardous to the errant vehicles leaving the roadway. Thus, clearing the trees alone will completely eliminate roadside safety issue. However, the densities of these other obstacles are generally far less than that of trees. Thus the roadsides should be considerably safer with proper clear zones established. In order to

make the roadside as safe as practical other obstacles need to be considered in the process and be cleared or treated to make roadside safe for errant vehicles.

Phase 3: Benefit/Cost analysis using Roadside Safety Analysis Program

Benefits and costs were analyzed for the following for crashes that were on secondary road and had similar site conditions (As mentioned in the methodology). Following five alternatives were considered in the analysis:

1. Existing conditions
2. Clear trees 14 feet from the edge of roadway
3. Providing guardrail protection

The existing conditions scenario had trees 1.8 feet from the edge of roadway. Second scenario had trees cleared to 7 feet and 14 feet from the roadway. The last scenario included a guardrail protection installed at 4 feet from the edge of roadway. The benefit-cost matrix obtained from the analysis is as tabulated below:

Table-38, Benefit-cost matrix

ALTERNATIVES	Existing Conditions	Clear trees 14 ft from the edge of road way	Install Guardrail
Existing Conditions	0	3.83	-1.92

The benefit-cost ratio increased with increase in the clear zone distance due to reduction in the annual crash frequency. Installation of guardrail had a negative benefit/cost ratio due to increase in the frequency of crashes and high initial cost of

installing it. However, on the long term, guardrail will be profitable due to reduction in the number of high severity crashes (fatal).

Phase 4: Identifying worst tree crash regions and road segments in South Carolina.

There were 14,506 tree crashes (2004 to 2006) in the state that were analyzed and assigned ranks based on kernel density, crash rate, county/route frequency and crash severity factors. A crash with the lowest rank in each of these categories would be considered the worst. The minimum cumulative rank possible was 4 while the minimum rank obtained was 7. Table-39 below shows the number of tree crashes classified with their respective rank.

Table-39, Number of tree crashes with their respective rank

RANK	NUMBER OF CRASHES
7	2
8	15
9	81
10	268
11	817
12	1658
13	3328
14	5265
15	3072
TOTAL CRASHES	14506

All the crashes with cumulative ranking less than 10 were selected for mapping. Figure-13 below shows the details of these locations.

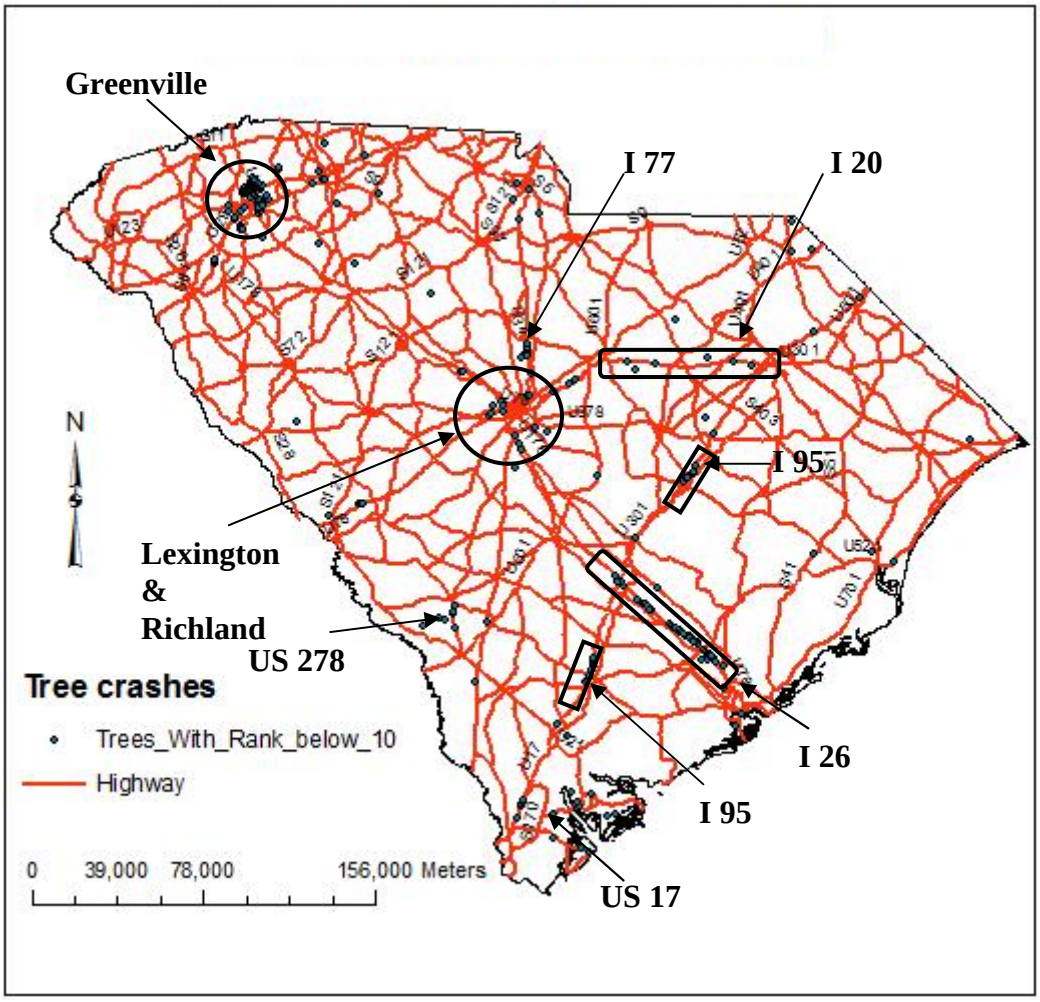

Figure-13, spatial location of tree crashes with rank less than 10.

Majority of the tree crashes were located in the counties of Greenville, Richland, and Lexington. Since Greenville and Columbia are major cities in the state the frequency of crashes are also high due to high volume of vehicles. Descriptive statistics of police accident reports also revealed that the county of Greenville, Richland and Lexington are the top three counties with highest number of tree crashes in the state. Table-39 below lists top 10 counties with roadside tree crashes. Approximately 50% of tree related crashes in SC occur in these 10 counties.

Table-40, Top 10 tree crash counties

TOP 10 TREE CRASH COUNTIES		
CTY-COUNTY	TOTAL CRASHES	RANK
GREENVILLE	1244	1
RICHLAND	1111	2
LEXINGTON	1003	3
CHARLESTON	993	4
SPARTANBURG	990	5
ANDERSON	810	6
BERKELEY	778	7
YORK	774	8
AIKEN	735	9
HORRY	692	10
TOTAL	9130	

Linear patterns of closely spaced tree crashes are observed on I 26, I 95, I 20, I 77, US 17 and US 278 (Figure-13). The descriptive statistics of the police accident reports also classified the above mentioned road segments among top ten stretches with highest number of tree crashes. Table-41, below lists top 10 road segments with highest number of tree crashes in the state.

Table-41, Top 10 tree crash roads

TOP 10 TREE CRASH ROADS		
ROAD NAME	TOTAL	RANK
I-95	737	1
I-26	671	2
I-20	308	3
US-17	305	4
US-76	181	5
I-77	172	6
US-21	142	7
S-54	120	8
US-178	114	9
US-321	113	10
TOTAL	2863	

CHAPTER 5

CONCLUSIONS

A multi-objective approach was taken to realize the goals of this project. This chapter will list all the objectives laid out in the beginning of the project and discuss respective conclusions from the study as follows:

1. Objective: Define the magnitude of tree crash problem in South Carolina.

   Trees are much bigger proportion of all roadside hazards in South Carolina than nationally.

2. Objective: Assess existing literature on tree crashes and countermeasures.

   The most effective countermeasure is clearing trees combined with continued vegetation management.

3. Objective: Analyze various factors associated with tree crashes

   Tree crashes are predominantly related to young male drivers, speeding and secondary roads. Speeding, DUI, and dark conditions prevail within the young male group for fatal tree crashes.

4. Objective: Evaluate clear zone sufficiency using existing data from the “Support for Elimination of Roadside Hazards” project.

   48 out of 51 sites reviewed did not meet minimum clear zone requirements. If tree-crash pattern exist, it is likely that minimum clear zones are not met.

5. Objective: Perform in depth analysis for sites where extensive clear zone data was collected.

The majority of sites analyzed had traversable side-slopes and clear zone width was the only problem. Many of the interstates had steep side-slopes and trees at the toe of the slopes.

6. Define range of potential benefit/Cost ratios for implementing clearing and other countermeasures.

   Benefit/cost ratios were positive clearing and negative for guardrail installation. Sites with side-slopes issues would also need earthwork which may reduce the benefit/cost for short term analysis.

7. Objective: Establish priority ranking method for tree crashes based on existing data and identify hazardous sites and road stretches in SC.

   By ranking the sites using the variety of methods, bias introduced by any one of the method is reduced. Additional weights could be applied to the matrix to customize to DOT goals and objectives.

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APPENDICES

APPENDIX A-TREE CRASH DATABASE (2004-2006)

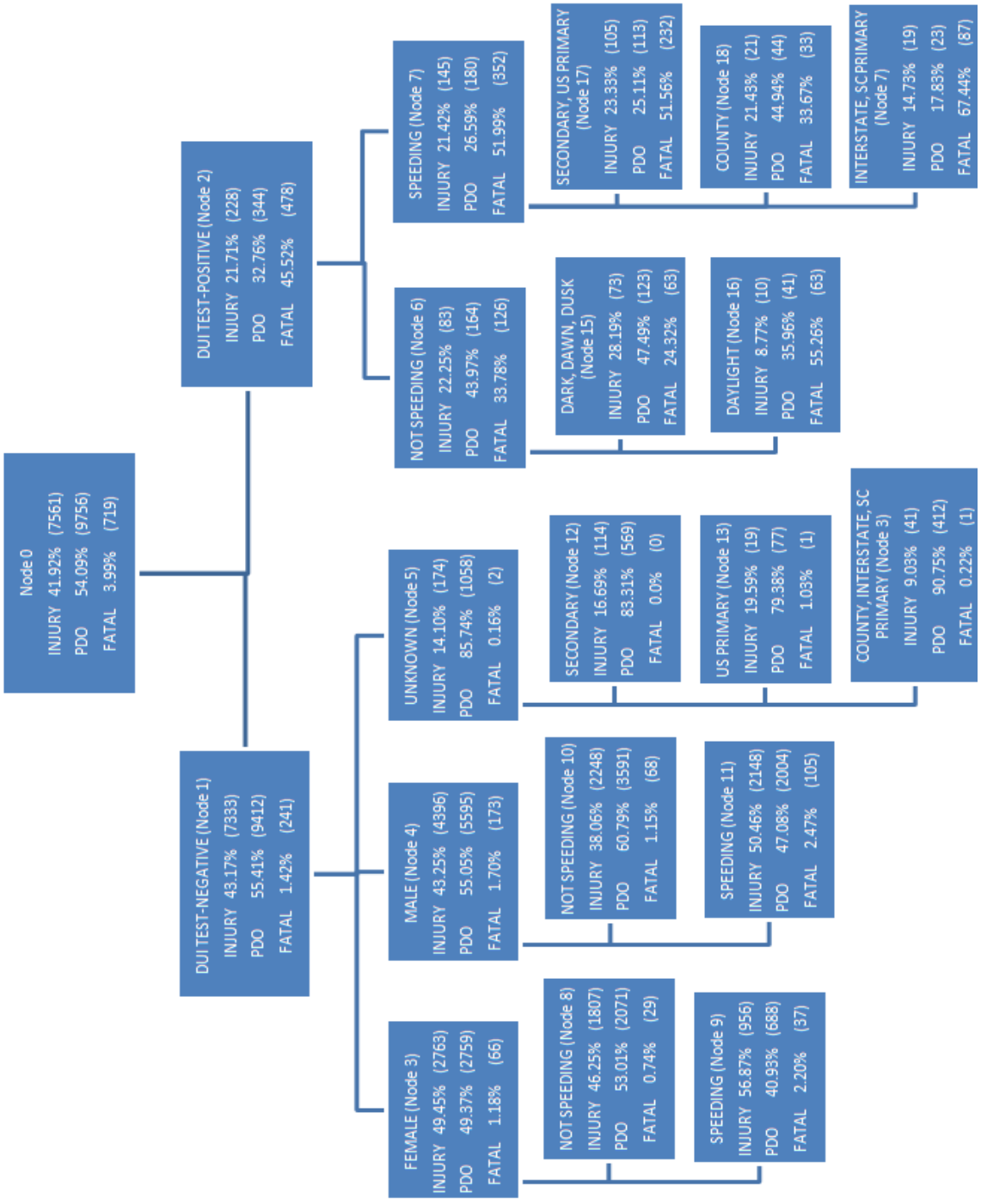
APPENDIX A (1): Variables Considered for Descriptive Statistics

VARIABLE NAME	DEFINATION
UNT	Number of Units Involved
CTY	County of Collision
RCT	Route Category
RTN	Route Number
ANO	Collision Number
FAT	Total Fatalities
INJ	Total Injuries
PDO	Total Property Damage Only
ALC	Light Condition
RSC	Road Surface
WCC	Weather Condition
TIM	Time of the Day
DAY	Day of the Week
FHE	First Harmful Event
PRC	Probable Cause
DOB	Date of Birth
DSEX	Driver Sex
DRAC	Driver Race
ECS	Estimated Collision Speed
SPL	Speed Limit
MHE	Most Harmful Event
CN2	Citation Number 2
ATG	Alcohol Test Given
DTG	Drug Test given
ATR2	Alcohol Test Results
DTR	Drug Test Results
SOE_1	Sequence of Events 1
SOE_2	Sequence of Events 2
SOE_3	Sequence of Events 3
SOE_4	Sequence of Events 4

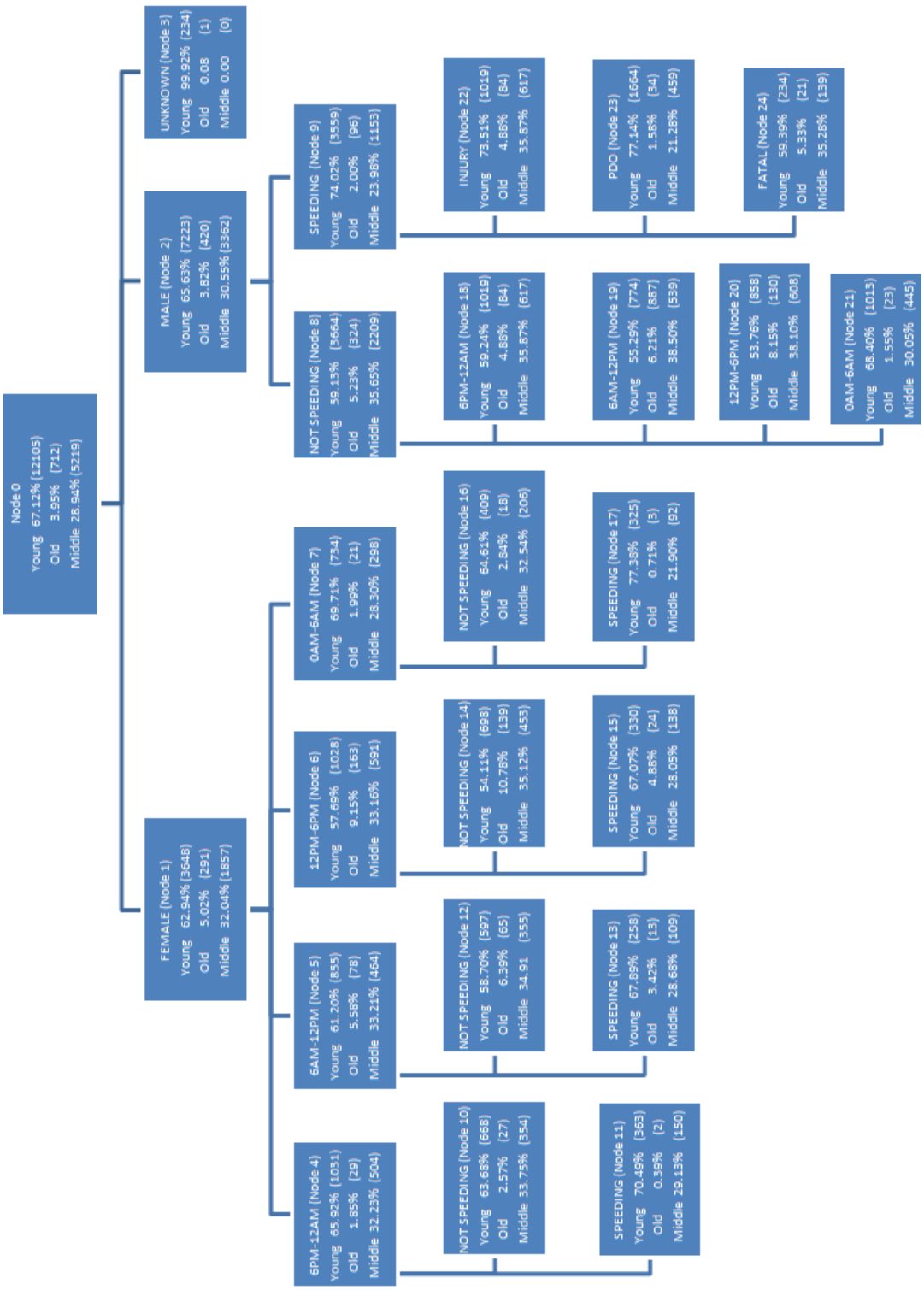
Note: Please check supplement files for tree crash database from 2004-2006

APPENDIX B: DECISION TREE DIAGRAMS FROM SPSS AnswerTree SOFTWARE

APPENDIX B (1): DECISION TREE DIAGRAM (CRASH SEVERITY)



APPENDIX B (1): DECISION TREE DIAGRAM (DRIVER AGE)



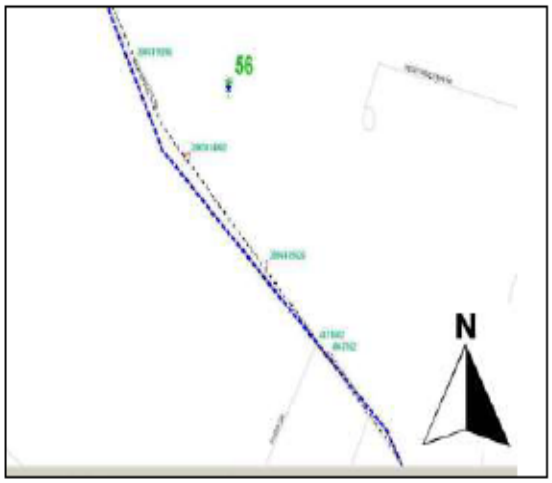
APPENDIX C: ROADSIDE CLEAR ZONE ANALYSIS RESULTS

COUNTY: Richland **NSITE ID: 56Trees**

SITE DETAILS

SITE ID:	56
NSITE ID:	56Trees
LATITUDE:	33923835
LONGITUDE:	-80893206
PRIMARY NAME:	US 76
SECONDARY NAME:	Old Hopkins RD
FUNCTIONAL CLASS:	Rural Major Collector
NO. OF LANES:	2
SPEED LIMIT:	45
ADT:	1800
CURVE:	No
DIRECTION:	NW

GIS



CLEARZONE ANALYSIS

ANO: 4047562

ADT:	1800	HORIZONTAL CURVE:	No
SPEED LIMIT(mph):	45	TOTAL AVAL. DISTANCE(ft)	12.2
DIRECTION:	NW	AVALIABLE CLEARZONE(ft)	8.5
INSPECTION TIME:	14:49:30	DESIRED CLEARZONE(ft):	16-18
INSPECTION DATE:	9/29/2008		

MINIMUM CLEARZONE NOT MET

COUNTY: Richland **NSITE ID:** 56Trees

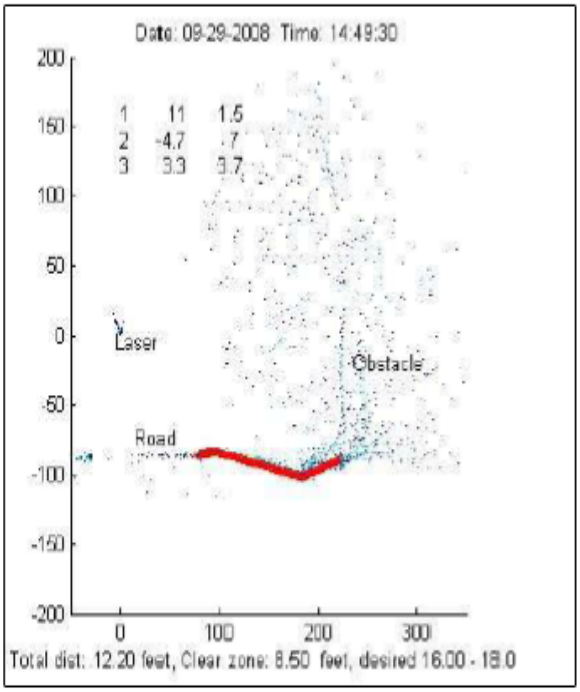
ANO: 4047562

Video Log Photo :

SITE DETAILS:

SITE ID:	56
NSITE ID:	56Trees
LATITUDE:	33923835
LONGITUDE:	-80893206
PRIMARY NAME	US 76
SECONDARY NAME	Old Hopkins RD
FUNC CLASS:	Rural Major Collector
NO. OF LANES	2
SPEED LIMIT (mph)	45
ADT:	1800
DIRECTION:	NW
HORZ. CURVE	No

Laser Measurement:

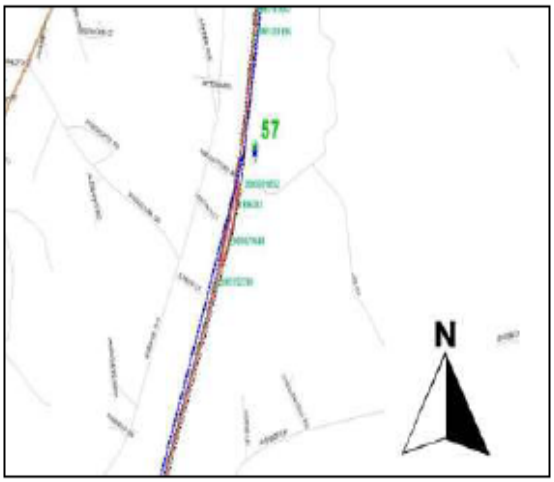


COUNTY: Orangeburg **NSITE ID: 57Trees**

SITE DETAILS

SITE ID:	57
NSITE ID:	57Trees
LATITUDE:	33444441
LONGITUDE:	-80483850
PRIMARY NAME:	I-95
SECONDARY NAME:	I95
FUNCTIONAL CLASS:	Rural Principal Arterial
NO. OF LANES:	4
SPEED LIMIT:	70
ADT:	26900
CURVE:	No
DIRECTION:	NE

GIS



CLEARZONE ANALYSIS

ANO: 2005039052

ADT:	26900	HORIZONTAL CURVE:	No
SPEED LIMIT(mph):	70	TOTAL AVAL. DISTANCE(ft)	17.97
DIRECTION:	NE	AVALIABLE CLEARZONE(ft)	15.81
INSPECTION TIME:	11:23:32	DESIRED CLEARZONE(ft):	28-30
INSPECTION DATE:	9/13/2008		

MINIMUM CLEARZONE NOT MET

COUNTY: Orangeburg **NSITE ID:** 57Trees

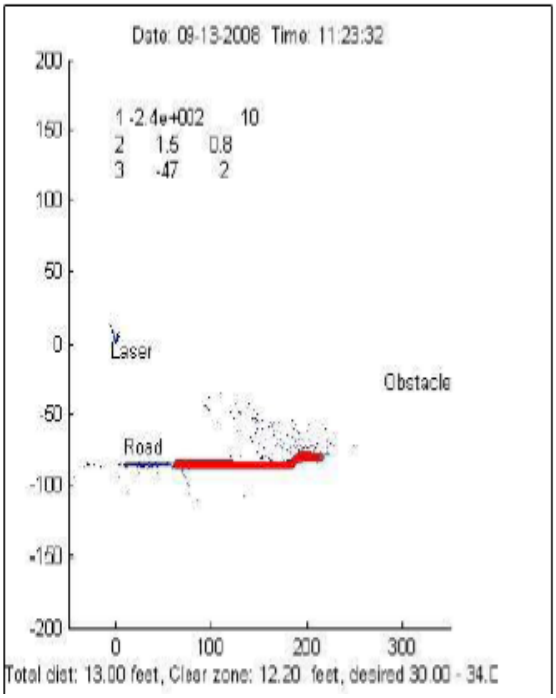
ANO: 2005039052

SITE DETAILS:

SITE ID:	57
NSITE ID:	57Trees
LATITUDE:	33444441
LONGITUDE:	-80483850
PRIMARY NAME	I-95
SECONDARY NAME	I95
FUNC CLASS:	Rural Principal Arterial
NO. OF LANES	4
SPEED LIMIT (mph)	70
ADT:	26900
DIRECTION:	NE
HORZ. CURVE	No

Video Log Photo :

Laser Measurement:

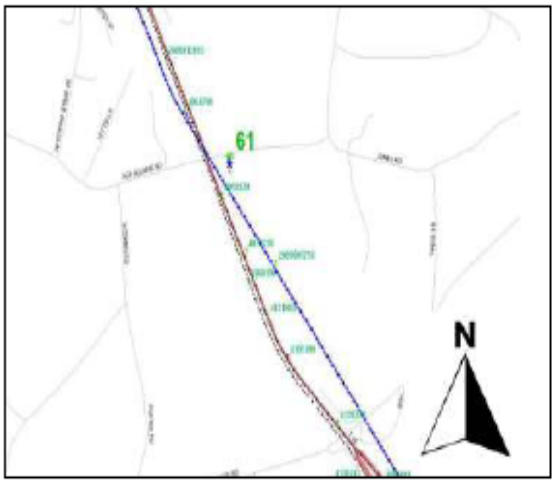


COUNTY: Orangeburg **NSITE ID: 61Trees**

SITE DETAILS

SITE ID:	61
NSITE ID:	61Trees
LATITUDE:	33486145
LONGITUDE:	-80757672
PRIMARY NAME:	I-26
SECONDARY NAME:	I26
FUNCTIONAL CLASS:	Rural Principal Arterial
NO. OF LANES:	4
SPEED LIMIT:	70
ADT:	43900
CURVE:	No
DIRECTION:	SW

GIS



CLEARZONE ANALYSIS

ANO: 2004118653

ADT:	43900	HORIZONTAL CURVE:	No
SPEED LIMIT(mph):	70	TOTAL AVAL. DISTANCE(ft)	14.67
DIRECTION:	SW	AVALIABLE CLEARZONE(ft)	12.11
INSPECTION TIME:	11:59:34	DESIRED CLEARZONE(ft):	28-30
INSPECTION DATE:	9/13/2008		

MINIMUM CLEARZONE NOT MET

COUNTY: **Orangeburg** **NSITE ID:** **61Trees**

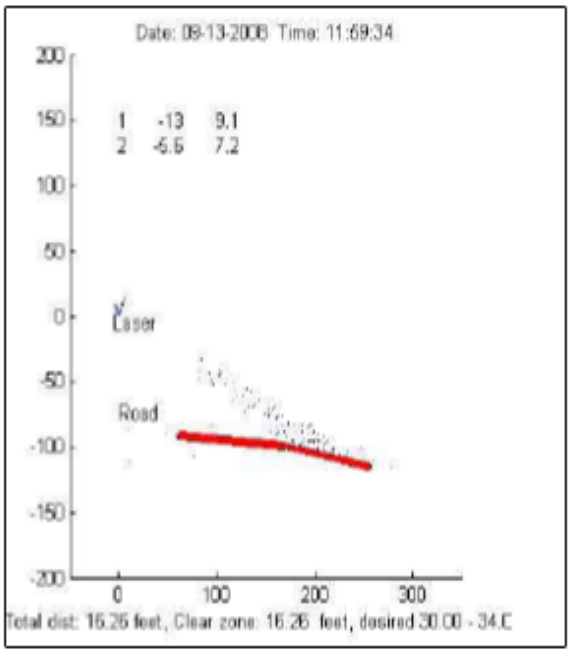
ANO: **2004118653**

Video Log Photo :

SITE DETAILS:

SITE ID:	61
NSITE ID:	61Trees
LATITUDE:	33486145
LONGITUDE:	-80757672
PRIMARY NAME	I-26
SECONDARY NAME	I26
FUNC CLASS:	Rural Principal Arterial
NO. OF LANES	4
SPEED LIMIT (mph)	70
ADT:	43900
DIRECTION:	SW
HORZ. CURVE	No

Laser Measurement:

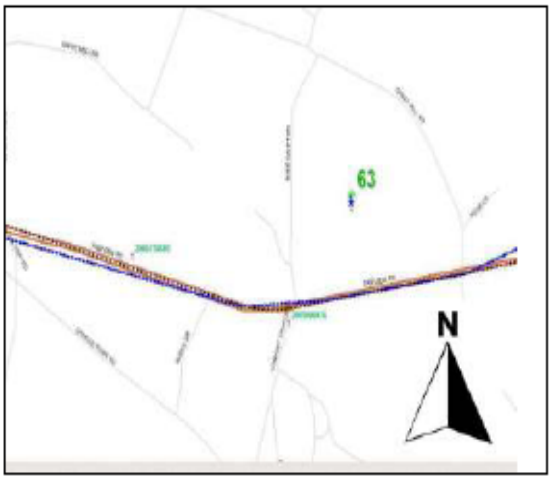


COUNTY: Lexington **NSITE ID: 63Trees**

SITE DETAILS

SITE ID:	63
NSITE ID:	63Trees
LATITUDE:	33755571
LONGITUDE:	-81332690
PRIMARY NAME:	Fairview RD
SECONDARY NAME:	Highway 178
FUNCTIONAL CLASS:	Rural Minor Arterial
NO. OF LANES:	2
SPEED LIMIT:	55
ADT:	2700
CURVE:	yes
DIRECTION:	NE

GIS



CLEARZONE ANALYSIS

ANO: 2006158805

ADT:	2700	HORIZONTAL CURVE:	yes
SPEED LIMIT(mph):	55	TOTAL AVAL. DISTANCE(ft)	12.96
DIRECTION:	NE	AVALIABLE CLEARZONE(ft)	12.96
INSPECTION TIME:	17:01:22	DESIRED CLEARZONE(ft):	22-24
INSPECTION DATE:	8/31/2008		

MINIMUM CLEARZONE NOT MET

COUNTY: **Lexington** **NSITE ID:** **63Trees**

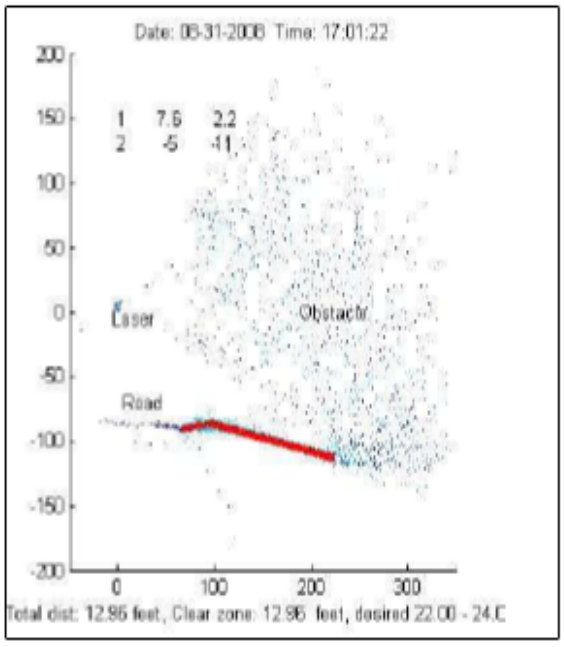
ANO: **2006158805**

Video Log Photo :

SITE DETAILS:

SITE ID:	63
NSITE ID:	63Trees
LATITUDE:	33755571
LONGITUDE:	-81332690
PRIMARY NAME	Fairview RD
SECONDARY NAME	Highway 178
FUNC CLASS:	Rural Minor Arterial
NO. OF LANES	2
SPEED LIMIT (mph)	55
ADT:	2700
DIRECTION:	NE
HORZ. CURVE	yes

Laser Measurement:

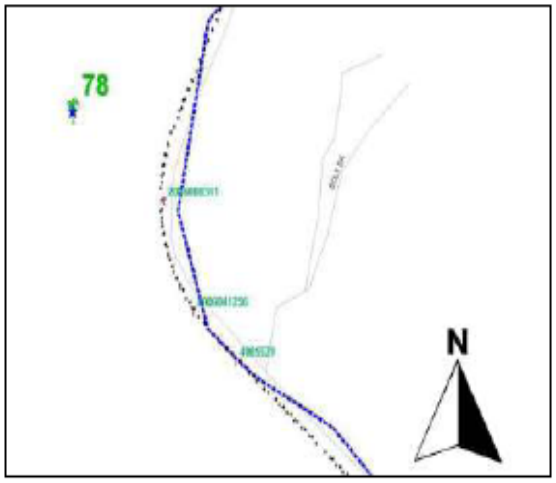


COUNTY: **Berkeley** **NSITE ID: 78Trees**

SITE DETAILS

SITE ID:	78
NSITE ID:	78Trees
LATITUDE:	33322070
LONGITUDE:	-80178193
PRIMARY NAME:	State Route 6
SECONDARY NAME:	Short Cut Rd
FUNCTIONAL CLASS:	Rural Major Collector
NO. OF LANES:	2
SPEED LIMIT:	45
ADT:	1600
CURVE:	yes
DIRECTION:	SE

GIS



CLEARZONE ANALYSIS

ANO: 2006008341

ADT:	1600	HORIZONTAL CURVE:	yes
SPEED LIMIT(mph):	45	TOTAL AVAL. DISTANCE(ft)	17.81
DIRECTION:	SE	AVALIABLE CLEARZONE(ft)	8.19
INSPECTION TIME:	14:54:41	DESIRED CLEARZONE(ft):	16-18
INSPECTION DATE:	9/14/2008		

MINIMUM CLEARZONE NOT MET

COUNTY: **Berkeley** **NSITE ID:** **78Trees**

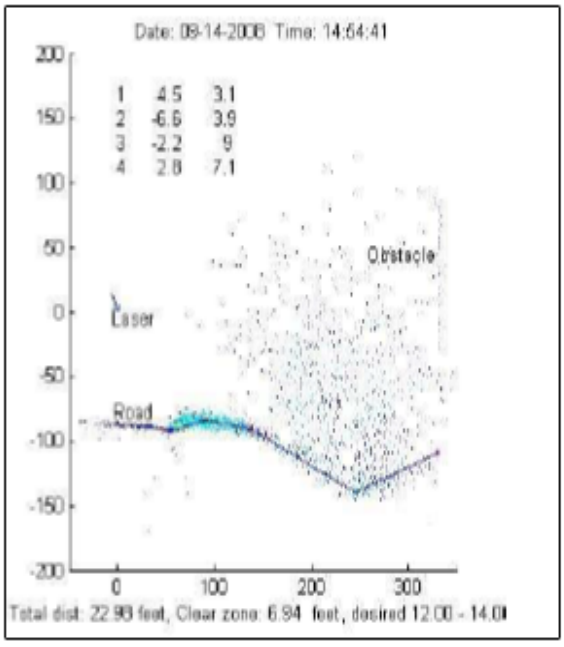
ANO: **2006008341**

Video Log Photo :

SITE DETAILS:

SITE ID:	78
NSITE ID:	78Trees
LATITUDE:	33322070
LONGITUDE:	-80178193
PRIMARY NAME	State Route 6
SECONDARY NAME	Short Cut Rd
FUNC CLASS:	Rural Major Collector
NO. OF LANES	2
SPEED LIMIT (mph)	45
ADT:	1600
DIRECTION:	SE
HORZ. CURVE	yes

Laser Measurement:

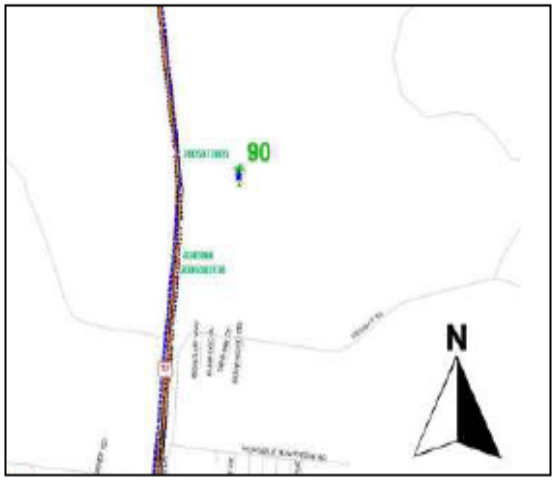


COUNTY: Berkeley **NSITE ID: 90Trees**

SITE DETAILS

SITE ID:	90
NSITE ID:	90Trees
LATITUDE:	33046016
LONGITUDE:	-80028969
PRIMARY NAME:	US Highway 52
SECONDARY NAME:	Highway 52
FUNCTIONAL CLASS:	Urban Principal Arterial
NO. OF LANES:	2
SPEED LIMIT:	60
ADT:	24800
CURVE:	yes
DIRECTION:	NW

GIS



CLEARZONE ANALYSIS

ANO: 2006111102

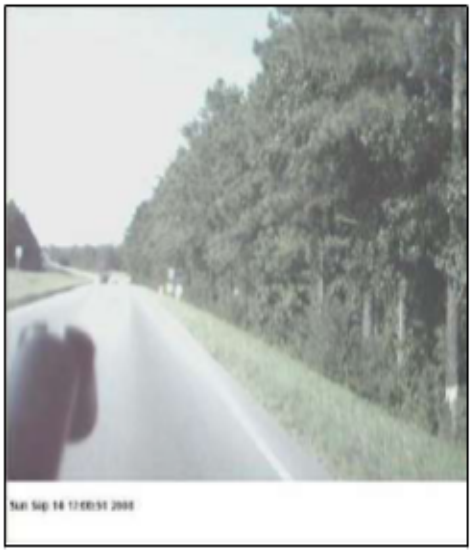
ADT:	24800	HORIZONTAL CURVE:	yes
SPEED LIMIT(mph):	60	TOTAL AVAL. DISTANCE(ft)	18.61
DIRECTION:	NW	AVALIABLE CLEARZONE(ft)	10.96
INSPECTION TIME:	17:00:51	DESIRED CLEARZONE(ft):	30-32
INSPECTION DATE:	9/14/2008		

MINIMUM CLEARZONE NOT MET

COUNTY: **Berkeley** **NSITE ID:** **90Trees**

ANO: **2006111102**

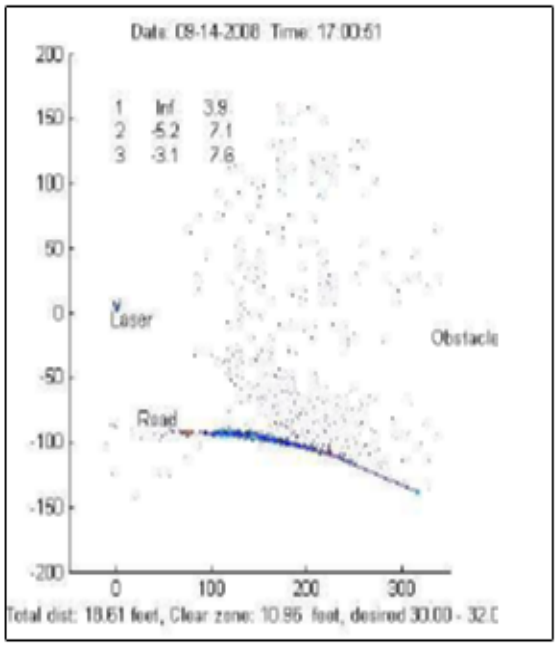
Video Log Photo :



SITE DETAILS:

SITE ID:	90
NSITE ID:	90Trees
LATITUDE:	33046016
LONGITUDE:	-80028969
PRIMARY NAME	US Highway 52
SECONDARY NAME	Highway 52
FUNC CLASS:	rban Principal Arterial
NO. OF LANES	2
SPEED LIMIT (mph)	60
ADT:	24800
DIRECTION:	NW
HORZ. CURVE	yes

Laser Measurement:



COUNTY: Richland **NSITE ID: 96Trees**

SITE DETAILS

SITE ID:	96
NSITE ID:	96Trees
LATITUDE:	33945352
LONGITUDE:	-80662614
PRIMARY NAME:	Garners Ferry RD
SECONDARY NAME:	Us Highway 378
FUNCTIONAL CLASS:	Rural Principal Arterial
NO. OF LANES:	2
SPEED LIMIT:	60
ADT:	16700
CURVE:	yes
DIRECTION:	NE

GIS

CLEARZONE ANALYSIS

ANO: 2006144302

ADT:	16700	HORIZONTAL CURVE:	yes
SPEED LIMIT(mph):	60	TOTAL AVAL. DISTANCE(ft)	18.56
DIRECTION:	NE	AVALIABLE CLEARZONE(ft)	16.52
INSPECTION TIME:	15:10:02	DESIRED CLEARZONE(ft):	30-32
INSPECTION DATE:	9/29/2008		

MINIMUM CLEARZONE NOT MET

COUNTY: **Richland** **NSITE ID:** **96Trees**

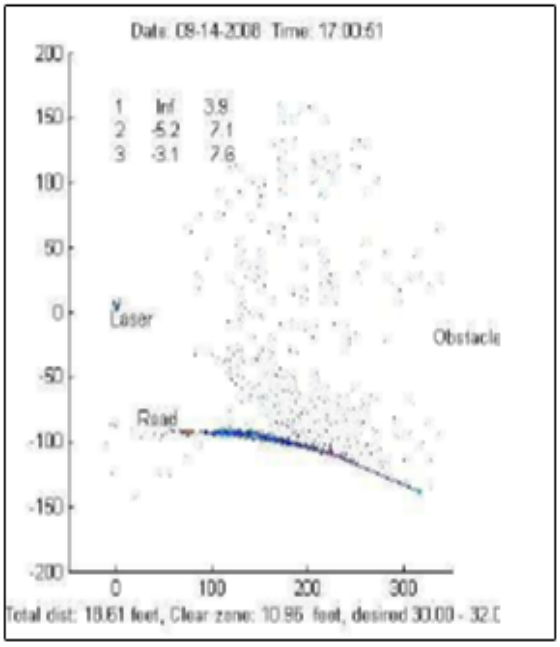
ANO: **2006144302**

SITE DETAILS:

SITE ID:	96
NSITE ID:	96Trees
LATITUDE:	33945352
LONGITUDE:	-80662614
PRIMARY NAME	Garners Ferry RD
SECONDARY NAME	Us Highway 378
FUNC CLASS:	Rural Principal Arterial
NO. OF LANES	2
SPEED LIMIT (mph)	60
ADT:	16700
DIRECTION:	NE
HORZ. CURVE	yes

Video Log Photo :

Laser Measurement:

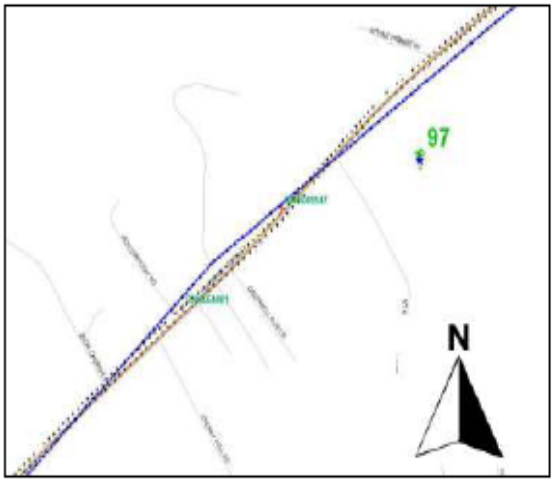


COUNTY: **Orangeburg** **NSITE ID: 97Trees**

SITE DETAILS

SITE ID:	97
NSITE ID:	97Trees
LATITUDE:	33470163
LONGITUDE:	-80920998
PRIMARY NAME:	Bamberg Higway
SECONDARY NAME:	Us Highway 301
FUNCTIONAL CLASS:	Rural Principal Arterial
NO. OF LANES:	4
SPEED LIMIT:	45
ADT:	13200
CURVE:	No
DIRECTION:	SW

GIS



CLEARZONE ANALYSIS

ANO: 2006064801

ADT:	13200	HORIZONTAL CURVE:	No
SPEED LIMIT(mph):	45	TOTAL AVAL. DISTANCE(ft)	8.04
DIRECTION:	SW	AVALIABLE CLEARZONE(ft)	7.78
INSPECTION TIME:	14:51:37	DESIRED CLEARZONE(ft):	18-20
INSPECTION DATE:	9/13/2008		

MINIMUM CLEARZONE NOT MET

COUNTY: **Orangeburg** **NSITE ID:** **97Trees**

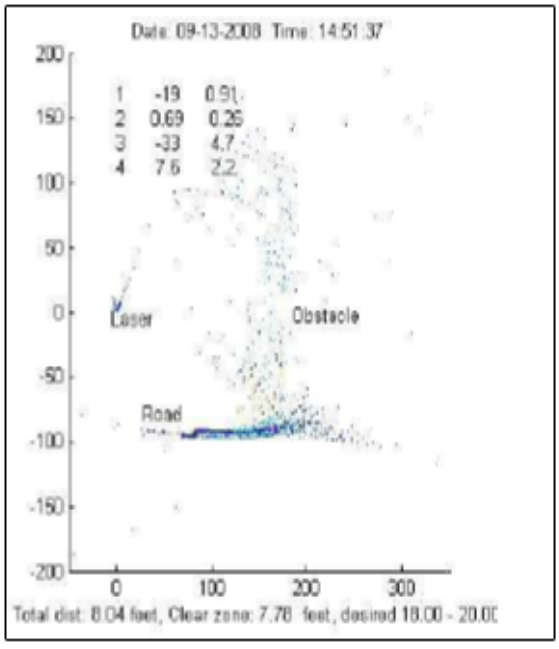
ANO: **2006064801**

SITE DETAILS:

SITE ID:	97
NSITE ID:	97Trees
LATITUDE:	33470163
LONGITUDE:	-80920998
PRIMARY NAME	Bamberg Higway
SECONDARY NAME	Us Highway 301
FUNC CLASS:	Rural Principal Arterial
NO. OF LANES	4
SPEED LIMIT (mph)	45
ADT:	13200
DIRECTION:	SW
HORZ. CURVE	No

Video Log Photo :

Laser Measurement:

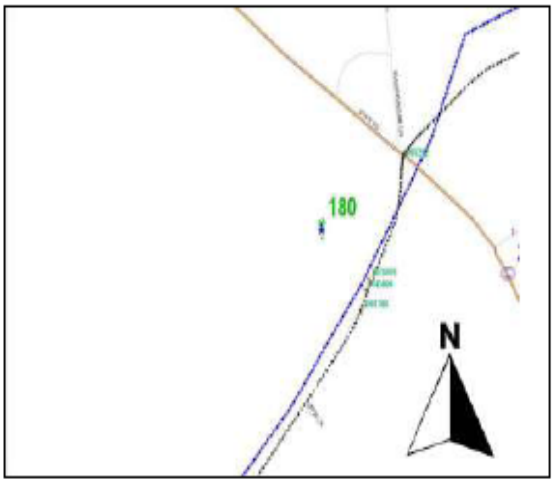


COUNTY: Berkeley **NSITE ID: 180Trees**

SITE DETAILS

SITE ID:	180
NSITE ID:	180Trees
LATITUDE:	33138240
LONGITUDE:	-80163723
PRIMARY NAME:	US 176
SECONDARY NAME:	Jedburg Rd
FUNCTIONAL CLASS:	Rural Major Collector
NO. OF LANES:	2
SPEED LIMIT:	45
ADT:	6200
CURVE:	No
DIRECTION:	SW

GIS



CLEARZONE ANALYSIS

ANO: 4145604

ADT:	6200	HORIZONTAL CURVE:	No
SPEED LIMIT(mph):	45	TOTAL AVAL. DISTANCE(ft)	10.79
DIRECTION:	SW	AVALIABLE CLEARZONE(ft)	5.58
INSPECTION TIME:	16:03:18	DESIRED CLEARZONE(ft):	16-18
INSPECTION DATE:	9/14/2008		

MINIMUM CLEARZONE NOT MET

COUNTY: **Berkeley** **NSITE ID:** **180Trees**

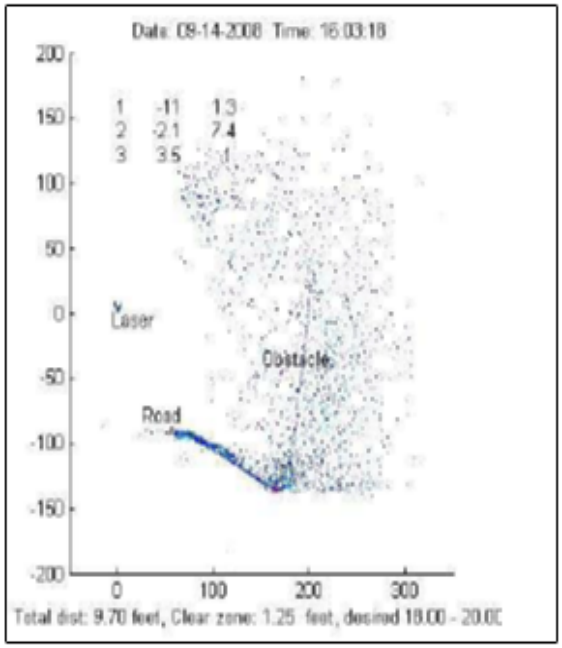
ANO: **4145604**

Video Log Photo :

SITE DETAILS:

SITE ID:	180
NSITE ID:	180Trees
LATITUDE:	33138240
LONGITUDE:	-80163723
PRIMARY NAME	US 176
SECONDARY NAME	Jedburg Rd
FUNC CLASS:	Rural Major Collector
NO. OF LANES	2
SPEED LIMIT (mph)	45
ADT:	6200
DIRECTION:	SW
HORZ. CURVE	No

Laser Measurement:

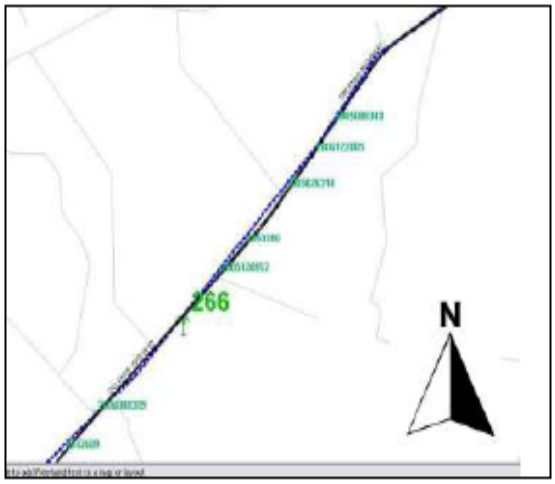


COUNTY: Dorchester **NSITE ID: 266Trees**

SITE DETAILS

SITE ID:	266
NSITE ID:	266Trees
LATITUDE:	32917730
LONGITUDE:	-80237409
PRIMARY NAME:	Delemar Highway
SECONDARY NAME:	State Highway 165
FUNCTIONAL CLASS:	Urban Principal Arterial
NO. OF LANES:	2
SPEED LIMIT:	55
ADT:	1850
CURVE:	No
DIRECTION:	SW

GIS



CLEARZONE ANALYSIS

ANO: 4063206

ADT:	1850	HORIZONTAL CURVE:	No
SPEED LIMIT(mph):	55	TOTAL AVAL. DISTANCE(ft)	18.67
DIRECTION:	SW	AVALIABLE CLEARZONE(ft)	9.81
INSPECTION TIME:	18:34:03	DESIRED CLEARZONE(ft):	20-22
INSPECTION DATE:	9/13/2008		

MINIMUM CLEARZONE NOT MET

COUNTY: **Dorchester** **NSITE ID:** **266Trees**

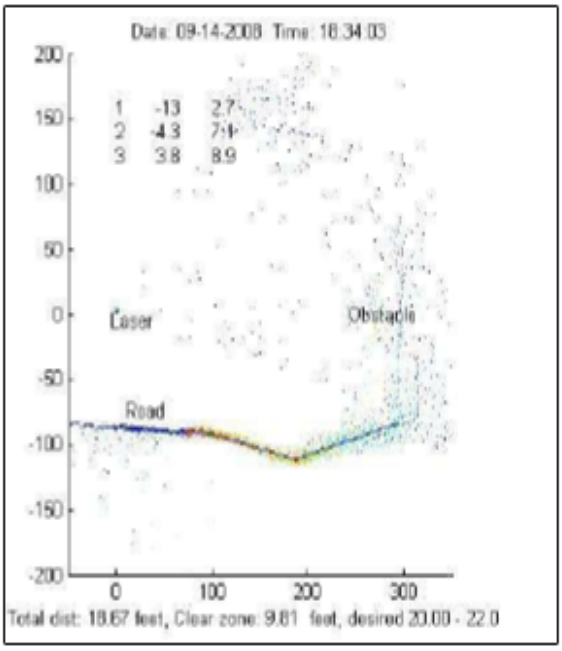
ANO: **4063206**

SITE DETAILS:

SITE ID:	266
NSITE ID:	266Trees
LATITUDE:	32917730
LONGITUDE:	-80237409
PRIMARY NAME	Delemar Highway
SECONDARY NAME	State Highway 165
FUNC CLASS:	rban Principal Arterial
NO. OF LANES	2
SPEED LIMIT (mph)	55
ADT:	1850
DIRECTION:	SW
HORZ. CURVE	No

Video Log Photo :

Laser Measurement:



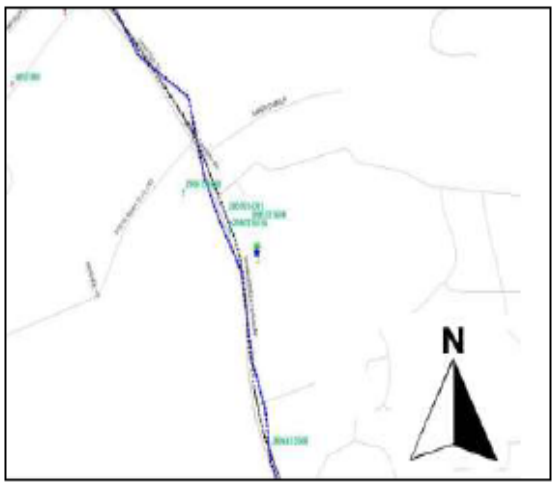
COUNTY: **Colleton**

NSITE ID: 274Trees

SITE DETAILS

SITE ID:	274
NSITE ID:	274Trees
LATITUDE:	32881322
LONGITUDE:	-80617417
PRIMARY NAME:	State Highway 64
SECONDARY NAME:	-
FUNCTIONAL CLASS:	Urban Principal Arterial
NO. OF LANES:	2
SPEED LIMIT:	55
ADT:	2200
CURVE:	yes
DIRECTION:	SE

GIS



CLEARZONE ANALYSIS

ANO: 2006136556

ADT:	2200	HORIZONTAL CURVE:	yes
SPEED LIMIT(mph):	55	TOTAL AVAL. DISTANCE(ft)	23.08
DIRECTION:	SE	AVALIABLE CLEARZONE(ft)	14.2
INSPECTION TIME:	10:30:53	DESIRED CLEARZONE(ft):	14-16
INSPECTION DATE:	9/14/2008		

MINIMUM CLEARZONE NOT MET

COUNTY: **Colleton** **NSITE ID:** **274Trees**

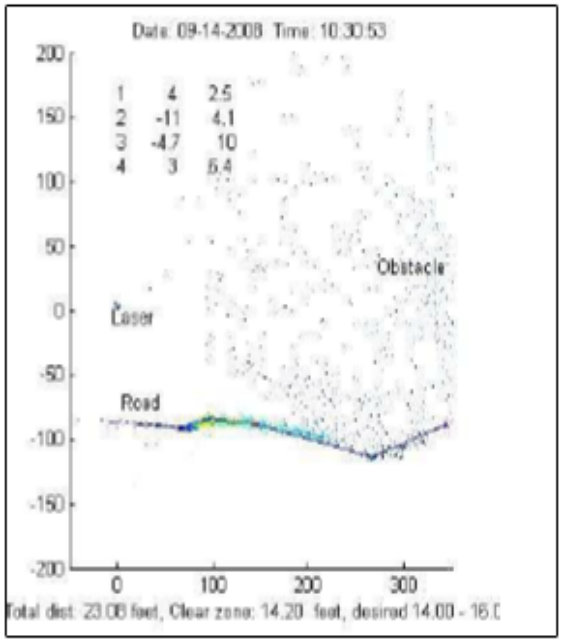
ANO: **2006136556**

Video Log Photo :

SITE DETAILS:

SITE ID:	274
NSITE ID:	274Trees
LATITUDE:	32881322
LONGITUDE:	-80617417
PRIMARY NAME	State Highway 64
SECONDARY NAME	-
FUNC CLASS:	rban Principal Arterial
NO. OF LANES	2
SPEED LIMIT (mph)	55
ADT:	2200
DIRECTION:	SE
HORZ. CURVE	yes

Laser Measurement:



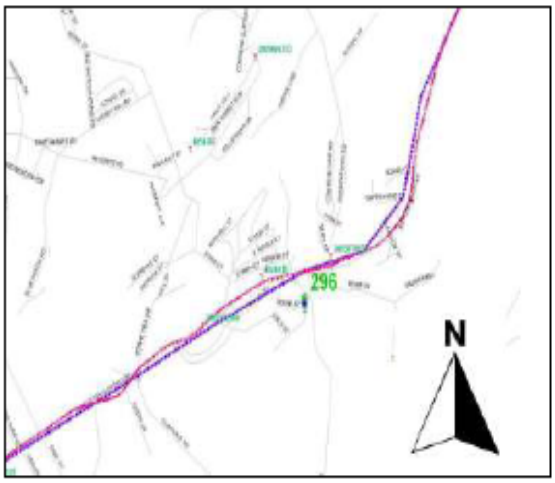
COUNTY: **Spartanburg**

NSITE ID: 296Trees

SITE DETAILS

SITE ID:	296
NSITE ID:	296Trees
LATITUDE:	34978826
LONGITUDE:	-81816285
PRIMARY NAME:	Beacon Light Rd
SECONDARY NAME:	State Rd S 42 59
FUNCTIONAL CLASS:	Rural Major Collector
NO. OF LANES:	2
SPEED LIMIT:	35
ADT:	2200
CURVE:	yes
DIRECTION:	SW

GIS



CLEARZONE ANALYSIS

ANO: 2005054653

ADT:	2200	HORIZONTAL CURVE:	yes
SPEED LIMIT(mph):	35	TOTAL AVAL. DISTANCE(ft)	11.37
DIRECTION:	SW	AVALIABLE CLEARZONE(ft)	6.24
INSPECTION TIME:	15:30:57	DESIRED CLEARZONE(ft):	12-14
INSPECTION DATE:	7/31/2008		

MINIMUM CLEARZONE NOT MET

COUNTY: **Spartanburg** **NSITE ID:** **296Trees**

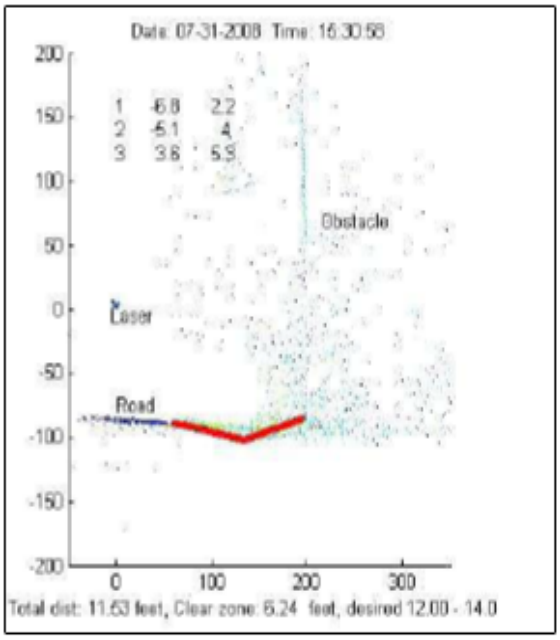
ANO: **2005054653**

SITE DETAILS:

SITE ID:	296
NSITE ID:	296Trees
LATITUDE:	34978826
LONGITUDE:	-81816285
PRIMARY NAME	Beacon Light Rd
SECONDARY NAME	State Rd S 42 59
FUNC CLASS:	Rural Major Collector
NO. OF LANES	2
SPEED LIMIT (mph)	35
ADT:	2200
DIRECTION:	SW
HORZ. CURVE	yes

Video Log Photo :

Laser Measurement:

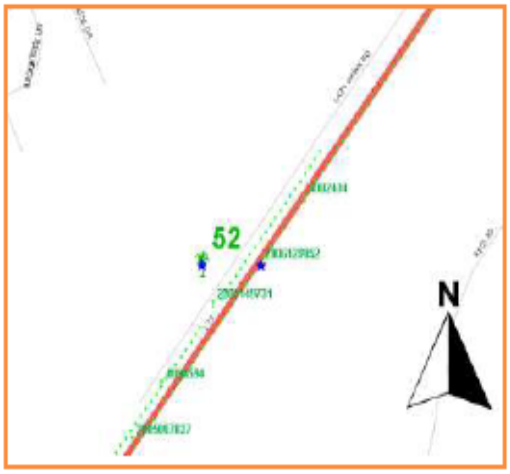


York SC **52Tree**

SITE DETAILS

SITE ID:	52
NSIT	52Tree
LATITUDE	34845838
LONGITUDE	-81020791
PRIMARY NAME:	I-77
SECONDARY NAME:	
ROUTE TYPE:	Interestate
LANES:	4
SPEED LIMIT (mph):	60
ADT:	41000
HRZL. CURVE	No
DIRECTION:	NE

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
52Tree	4082434	Tree	Not Injured
52Tree	4098594	Overturn/Roll Over	Possible
52Tree	2005087027	Tree	Possible
52Tree	2005149731	Tree	Not Injured
52Tree	2006129852	Tree	Not Injured

CLEARZONE ANALYSIS

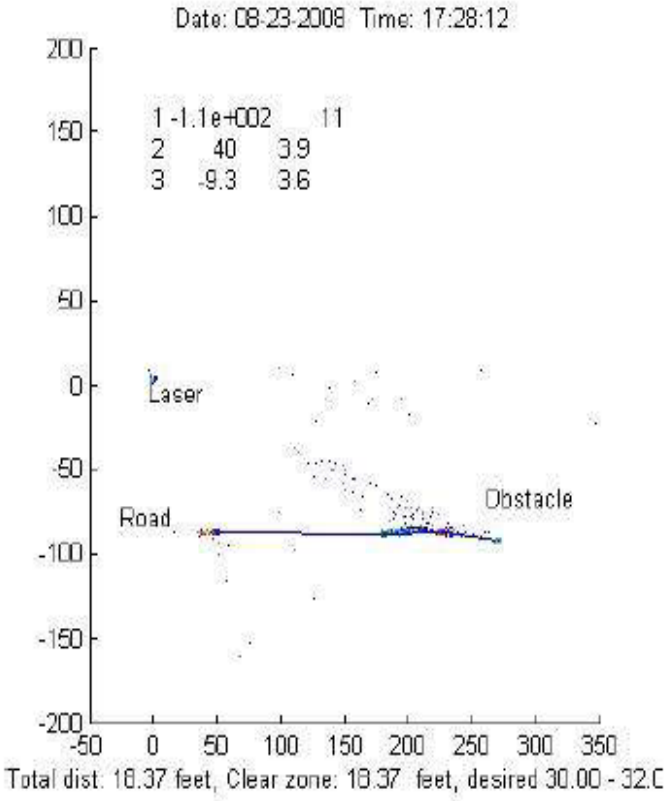
ANO: 2006129852

ADT :	41000	HRZL CURVE	No
SPEED LIMIT(mph)	60	TOTAL AVAL DISTANCE(ft)	18.37
DIRECTION	NE	APPLICABLE CLEAR ZONE(ft)	18.37
INSPECTION TIM	17:28:12	DESIRED CLEAR ZONE(ft)	30-32
INSPECTION DATE:	8/23/2008		

Minimum Clearzone Not Met

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	52Tree
LONGITUDE:	-81020791
LATITUDE:	34845833
PRIMARY NAME:	I-77
SECONDARY NAME:	
ROUTE TYPE:	Interestate
LANE	4
SPEED LIMIT (mph):	60
ADT:	41000
DIRECTION:	NE
HRZL CURVE:	No

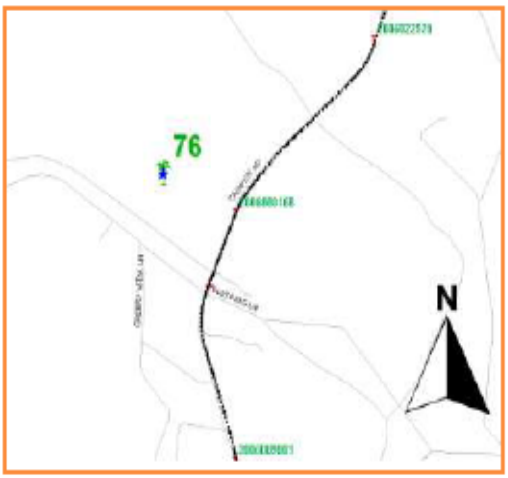
VIDEO -LOG PHOTO

Berkeley SC **76Tree**

SITE DETAILS

SITE ID:	76
NSIT	76Tree
LATITUDE	33019003
LONGITUDE	-79807006
PRIMARY NAME:	State Highway 41
SECONDARY NAME:	
ROUTE TYPE:	SC Primary
LANES:	2
SPEED LIMIT (mph):	45
ADT:	1200
HRZL. CURVE	Yes
DIRECTION:	SW

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
76Tree	4024566	Tree	Possible
76Tree	4030894	Tree	Not Injured
76Tree	4047511	Tree	Possible
76Tree	2006080168	Tree	Not Injured
76Tree	2006124354	Tree	Possible

CLEARZONE ANALYSIS

ANO: 2006080168

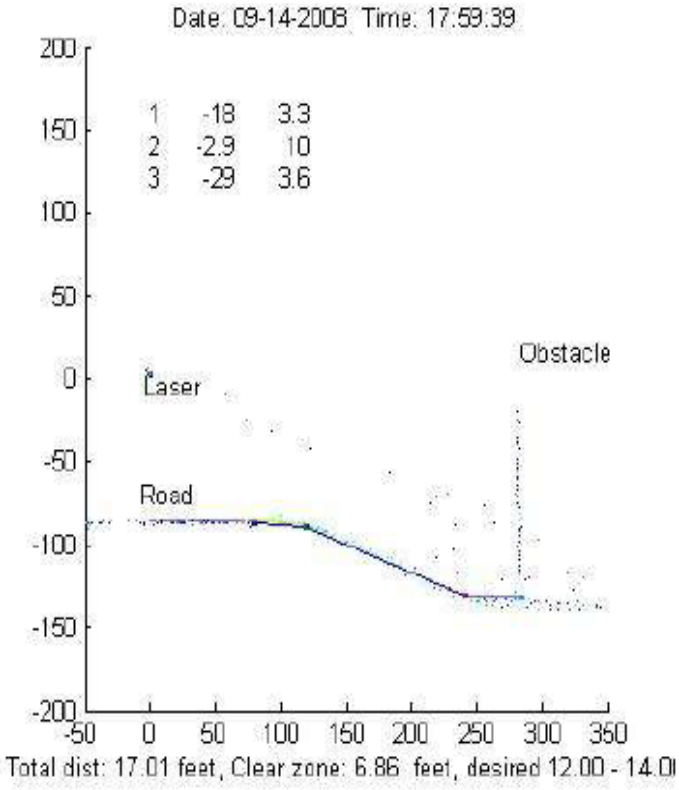
ADT :	1200	HRZL CURVE	Yes
SPEED LIMIT(mph)	45	TOTAL AVAL DISTANCE(ft)	17.01
DIRECTION	SW	APPLICABLE CLEAR ZONE(ft)	6.96
INSPECTION TIM	17:59:39	DESIRED CLEAR ZONE(ft)	12-14
INSPECTION DATE:	9/14/2008		

Minimum Clearzone Not Met

Berkeley SC **76Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	76Tree
LONGITUDE:	-79807006
LATITUDE:	33057528
PRIMARY NAME:	State Highway 41
SECONDARY NAME:	
ROUTE TYPE:	SC Primary
LANE	2
SPEED LIMIT (mph):	45
ADT:	1200
DIRECTION:	SW
HRZL CURVE:	Yes

VIDEO -LOG PHOTO

York SC **84Tree**

SITE DETAILS

SITE ID:	84
NSIT	84Tree
LATITUDE	34893218
LONGITUDE	-80950474
PRIMARY NAME:	S Anderson RD
SECONDARY NAME:	State Highway 5
ROUTE TYPE:	US Primary
LANES:	4
SPEED LIMIT (mph):	45
ADT:	17400
HRZL. CURVE	No
DIRECTION:	NW

GIS:

Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
84Tree	4072325	Tree	Incapacitating
84Tree	4107692	Animal(All Other)	Not Injured
84Tree	4138903	Tree	Not Injured
84Tree	4145732	Tree	Possible
84Tree	2005028452	Motor Vehicle(In Transport)	Possible
84Tree	2005028935	Tree	Non-incapacitating
84Tree	2006096914	Tree	Possible
84Tree	2006113724	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 2006113724

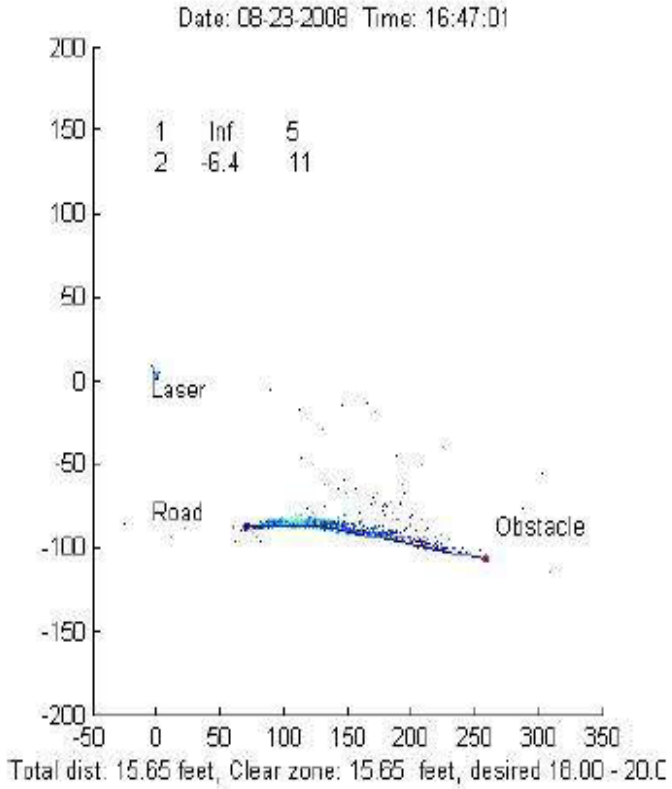
ADT :	17400	HRZL CURVE	No
SPEED LIMIT(mph)	45	TOTAL AVAL DISTANCE(ft)	15.65
DIRECTION	NW	APPLICABLE CLEAR ZONE(ft)	15.65
INSPECTION TIM	16:47:01	DESIRED CLEAR ZONE(ft)	18-20
INSPECTION DATE:	8/23/2008		

Minimum Clearzone Not Met

York SC **84Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	84Tree
LONGITUDE:	-80950474
LATITUDE:	34899139
PRIMARY NAME:	S Anderson RD
SECONDARY NAME:	State Highway 5
ROUTE TYPE:	US Primary
LANE	4
SPEED LIMIT (mph):	45
ADT:	17400
DIRECTION:	NW
HRZL CURVE:	No

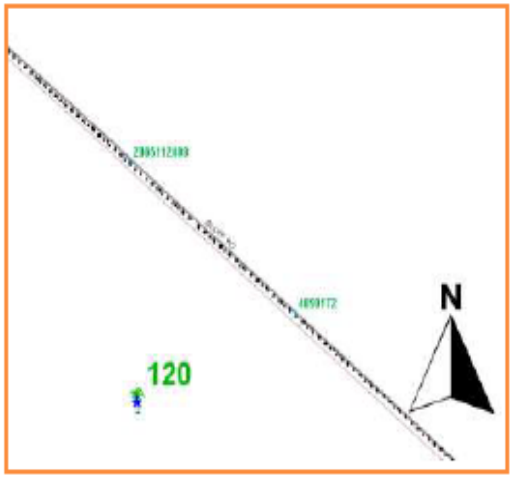
VIDEO -LOG PHOTO

Richland SC **120Tree**

SITE DETAILS

SITE ID:	120
NSIT	120Tree
LATITUDE	33912222
LONGITUDE	-80940806
PRIMARY NAME:	Bluff Rd
SECONDARY NAME:	State Hwy 48
ROUTE TYPE:	SC Primary
LANES:	2
SPEED LIMIT (mph):	45
ADT:	7200
HRZL. CURVE	No
DIRECTION:	SE

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
120Tree	4038650	Tree	Non-incapacitating
120Tree	4050172	Tree	Possible
120Tree	4108125	Tree	Not Injured
120Tree	4119918	Enbankment	Possible
120Tree	2005004512	Tree	Possible
120Tree	2005033577	Tree	Possible
120Tree	2005112488	Tree	Non-incapacitating
120Tree	2005121682	Tree	Incapacitating
120Tree	2006144810	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 4050172

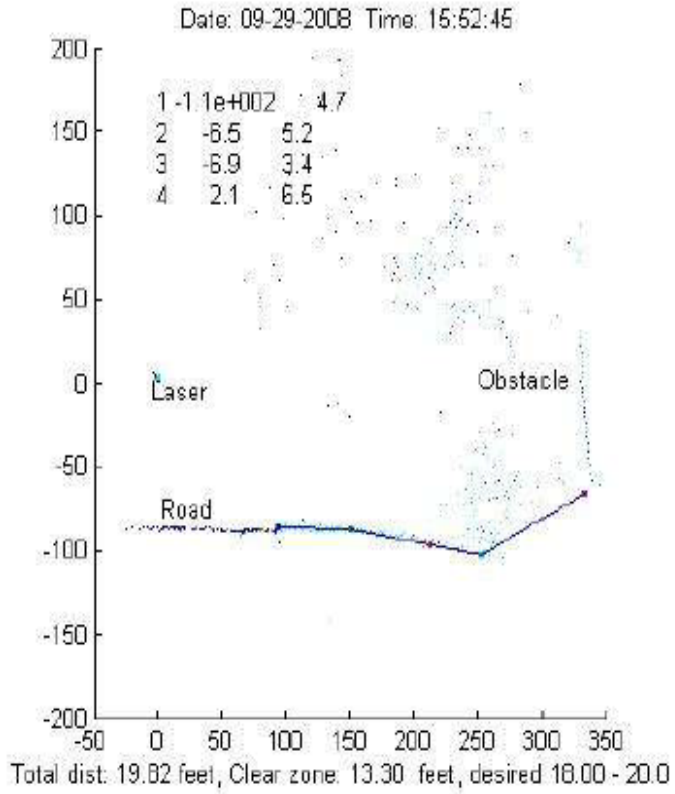
ADT :	7200	HRZL CURVE	No
SPEED LIMIT(mph)	45	TOTAL AVAL DISTANCE(ft)	19.82
DIRECTION	SE	APPLICABLE CLEAR ZONE(ft)	13.3
INSPECTION TIM	15:52:45	DESIRED CLEAR ZONE(ft)	18-20
INSPECTION DATE:	9/29/2008		

Minimum Clearzone Not Met

Richland SC **120Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	120Tree
LONGITUDE:	-80940806
LATITUDE:	33912222
PRIMARY NAME:	Bluff Rd
SECONDARY NAME:	State Hwy 48
ROUTE TYPE:	SC Primary
LANE	2
SPEED LIMIT (mph):	45
ADT:	7200
DIRECTION:	SE
HRZL CURVE:	No

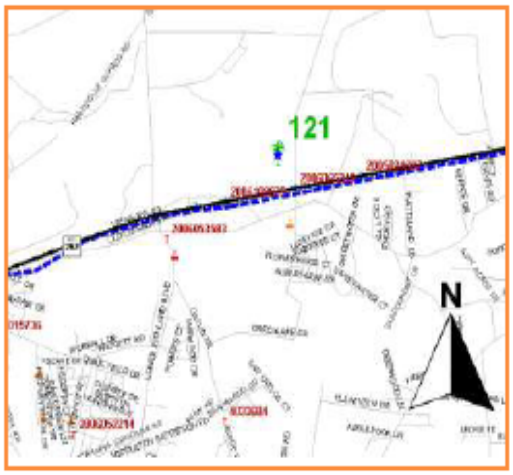
VIDEO -LOG PHOTO

Richland SC **121Tree**

SITE DETAILS

SITE ID:	121
NSIT	121Tree
LATITUDE	33998012
LONGITUDE	-80850161
PRIMARY NAME:	Leesburg RD
SECONDARY NAME:	State Highway 262
ROUTE TYPE:	SC Primary
LANES:	2
SPEED LIMIT (mph):	55
ADT:	7400
HRZL. CURVE	No
DIRECTION:	NE

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
121Tree	4086381	Motor Vehicle(In Transport)	Not Injured
121Tree	2005024697	Tree	Possible
121Tree	2006065248	Tree	Possible
121Tree	2006108875	Tree	Possible
121Tree	2006130358	Tree	Not Injured
121Tree	2006133725	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 2005024697

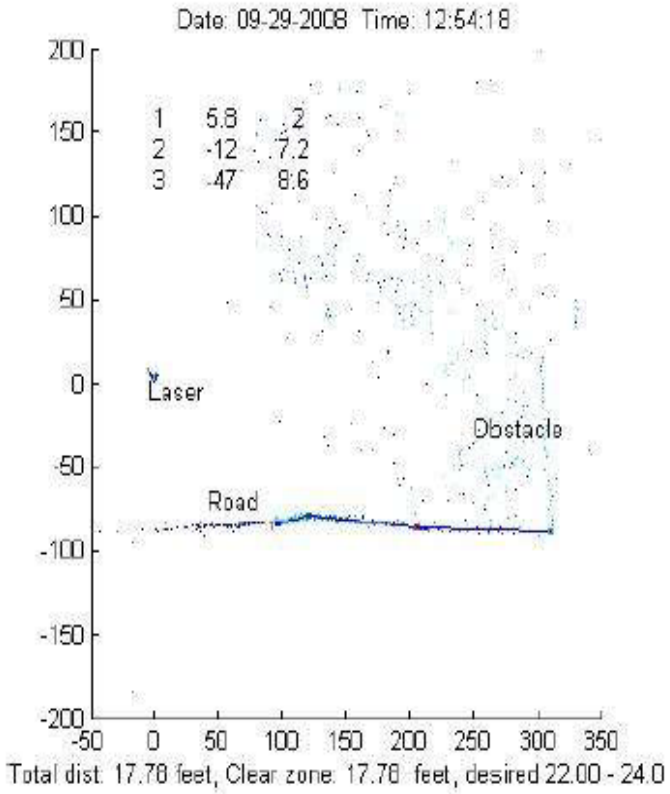
ADT :	7400	HRZL CURVE	No
SPEED LIMIT(mph)	55	TOTAL AVAL DISTANCE(ft)	17.78
DIRECTION	NE	APPLICABLE CLEAR ZONE(ft)	17.78
INSPECTION TIM	12:54:18	DESIRED CLEAR ZONE(ft)	22-24
INSPECTION DATE:	9/29/2008		

Minimum Clearzone Not Met

Richland SC **121Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	121Tree
LONGITUDE:	-80850161
LATITUDE:	33995750
PRIMARY NAME:	Leesburg RD
SECONDARY NAME:	State Highway 262
ROUTE TYPE:	SC Primary
LANE	2
SPEED LIMIT (mph):	55
ADT:	7400
DIRECTION:	NE
HRZL CURVE:	No

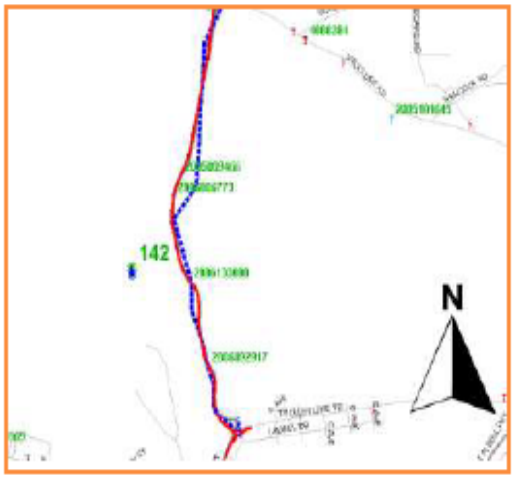
VIDEO -LOG PHOTO

Aiken SC **142Tree**

SITE DETAILS

SITE ID:	142
NSIT	142Tree
LATITUDE	33587616
LONGITUDE	-81816496
PRIMARY NAME:	Senn St
SECONDARY NAME:	State Highway 191
ROUTE TYPE:	SC Primary
LANES:	2
SPEED LIMIT (mph):	30
ADT:	1900
HRZL. CURVE	Yes
DIRECTION:	NS

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
142Tree	2005009466	Tree	Possible
142Tree	2005086464	Tree	Not Injured
142Tree	2006006773	Tree	Not Injured
142Tree	2006092917	Tree	Possible
142Tree	2006133008	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 2006006773

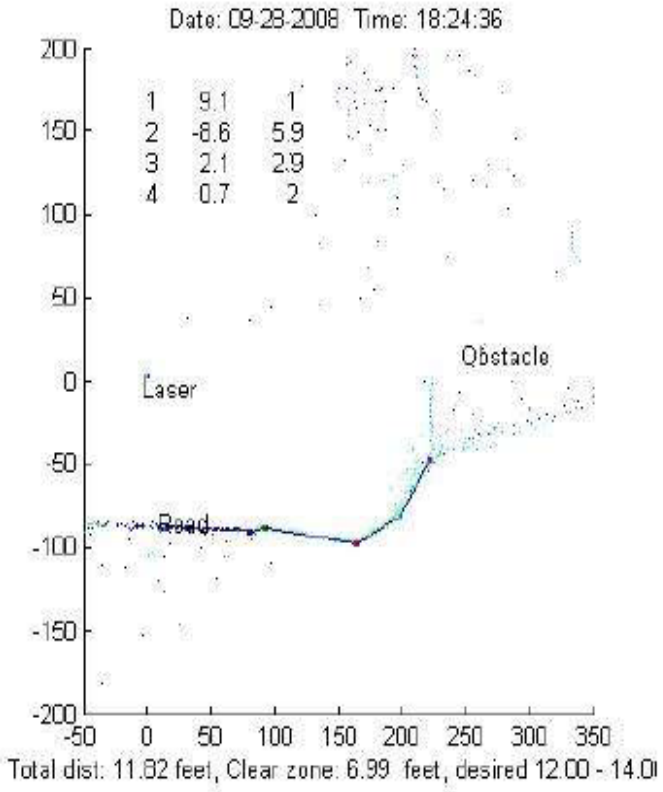
ADT :	1900	HRZL CURVE	Yes
SPEED LIMIT(mph)	30	TOTAL AVAL DISTANCE(ft)	11.82
DIRECTION	NS	APPLICABLE CLEAR ZONE(ft)	6.99
INSPECTION TIM	18:24:36	DESIRED CLEAR ZONE(ft)	12-14
INSPECTION DATE:	9/28/2008		

Minimum Clearzone Not Met

Aiken SC **142Tree**

ANO

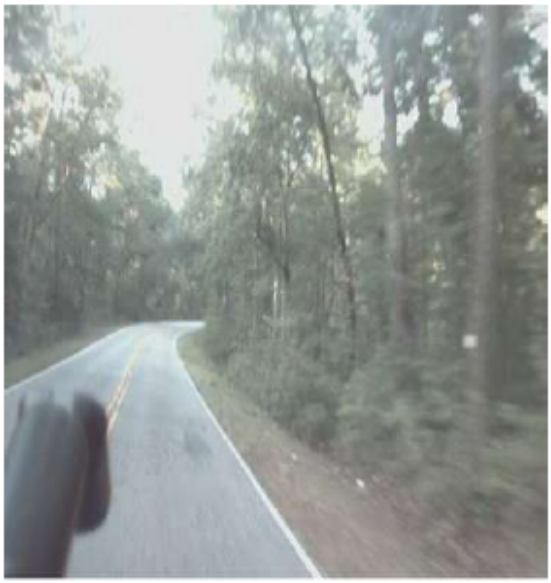
LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	142Tree
LONGITUDE:	-81816496
LATITUDE:	33593806
PRIMARY NAME:	Senn St
SECONDARY NAME:	State Highway 191
ROUTE TYPE:	SC Primary
LANE	2
SPEED LIMIT (mph):	30
ADT:	1900
DIRECTION:	NS
HRZL CURVE:	Yes

VIDEO -LOG PHOTO

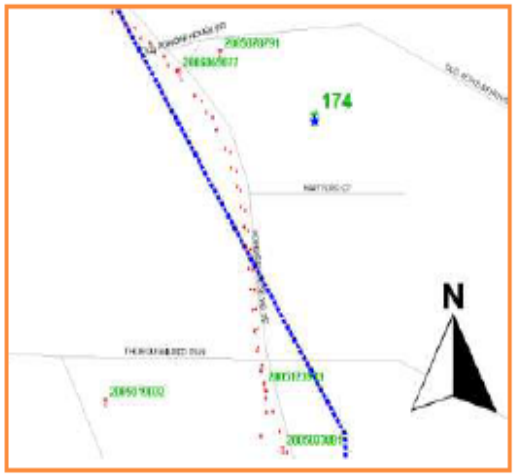


Aiken SC **174Tree**

SITE DETAILS

SITE ID:	174
NSIT	174Tree
LATITUDE	33522356
LONGITUDE	-81696757
PRIMARY NAME:	owderHouse RD SE
SECONDARY NAME:	State Highway 440
ROUTE TYPE:	Secondary
LANES:	2
SPEED LIMIT (mph):	35
ADT:	4500
HRZL. CURVE	Yes
DIRECTION:	SE

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
174Tree	4021581	Tree	Not Injured
174Tree	2005025864	Tree	Possible
174Tree	2005033081	Tree	Not Injured
174Tree	2005078791	Tree	Non-incapacitating
174Tree	2005123933	Tree	Possible
174Tree	2006069077	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 2006069077

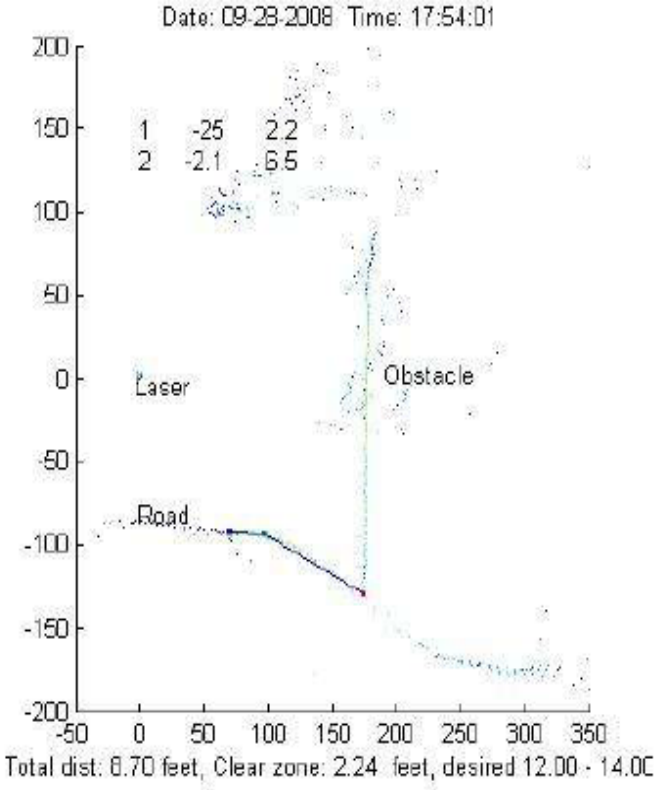
ADT :	4500	HRZL CURVE	Yes
SPEED LIMIT(mph)	35	TOTAL AVAL DISTANCE(ft)	8.7
DIRECTION	SE	APPLICABLE CLEAR ZONE(ft)	2.24
INSPECTION TIM	17:54:01	DESIRED CLEAR ZONE(ft)	12-14
INSPECTION DATE:	9/28/2008		

Minimum Clearzone Not Met

Aiken SC **174Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	174Tree
LONGITUDE:	-81696757
LATITUDE:	33525333
PRIMARY NAME:	owderHouse RD SE
SECONDARY NAME:	State Highway 440
ROUTE TYPE:	Secondary
LANE	2
SPEED LIMIT (mph):	35
ADT:	4500
DIRECTION:	SE
HRZL CURVE:	Yes

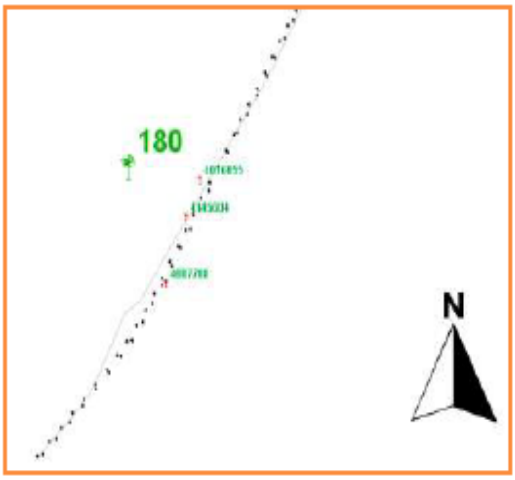
VIDEO -LOG PHOTO

Berkeley SC **180Tree**

SITE DETAILS

SITE ID:	180
NSIT	180Tree
LATITUDE	33139953
LONGITUDE	-80165587
PRIMARY NAME:	Jedburg RD
SECONDARY NAME:	
ROUTE TYPE:	Secondary
LANES:	2
SPEED LIMIT (mph):	45
ADT:	5600
HRZL. CURVE	No
DIRECTION:	SW

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
180Tree	4007788	Tree	Possible
180Tree	4076055	Tree	Non-incapacitating
180Tree	4145604	Tree	Possible

CLEARZONE ANALYSIS

ANO: 4145604

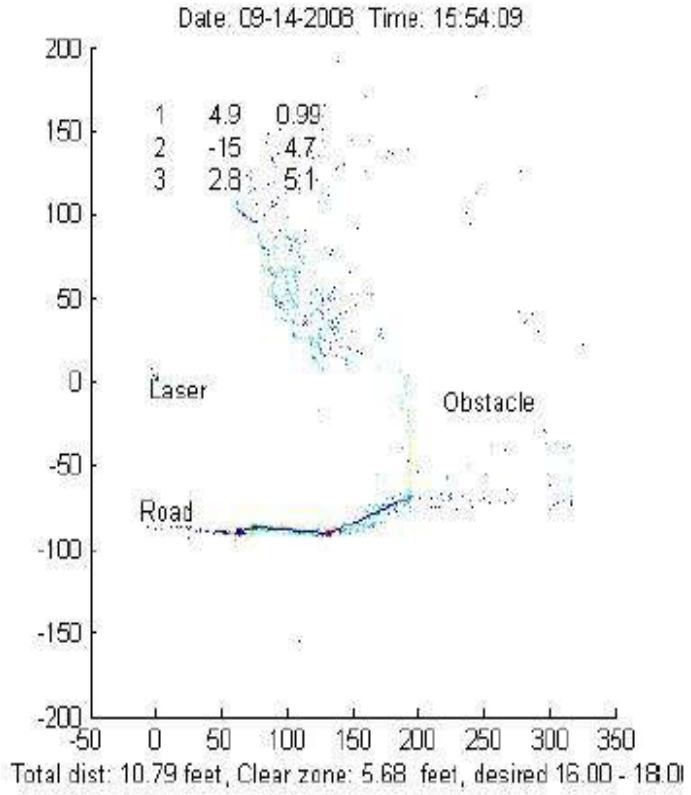
ADT :	5600	HRZL CURVE	No
SPEED LIMIT(mph)	45	TOTAL AVAL DISTANCE(ft)	10.79
DIRECTION	SW	APPLICABLE CLEAR ZONE(ft)	5.68
INSPECTION TIM	15:54:09	DESIRED CLEAR ZONE(ft)	16-18
INSPECTION DATE:	9/14/2008		

Minimum Clearzone Not Met

Berkeley SC **180Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	180Tree
LONGITUDE:	-80165587
LATITUDE:	33137731
PRIMARY NAME:	Jedburg RD
SECONDARY NAME:	
ROUTE TYPE:	Secondary
LANE	2
SPEED LIMIT (mph):	45
ADT:	5600
DIRECTION:	SW
HRZL CURVE:	No

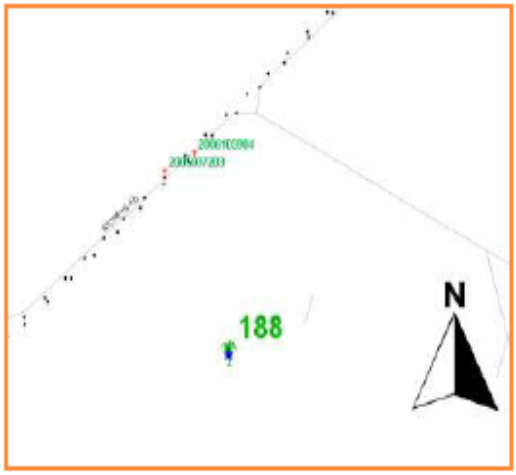
VIDEO -LOG PHOTO

Colleton SC **188Tree**

SITE DETAILS

SITE ID:	188
NSIT	188Tree
LATITUDE	32986421
LONGITUDE	-80575262
PRIMARY NAME:	Sidney RD
SECONDARY NAME:	State Highway
ROUTE TYPE:	Secondary
LANES:	2
SPEED LIMIT (mph):	55
ADT:	1950
HRZL. CURVE	No
DIRECTION:	SW

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
188Tree	2005037203	Tree	Not Injured
188Tree	2006033978	Tree	Incapacitating
188Tree	2006103904	Tree	Possible

CLEARZONE ANALYSIS

ANO: 2005037203

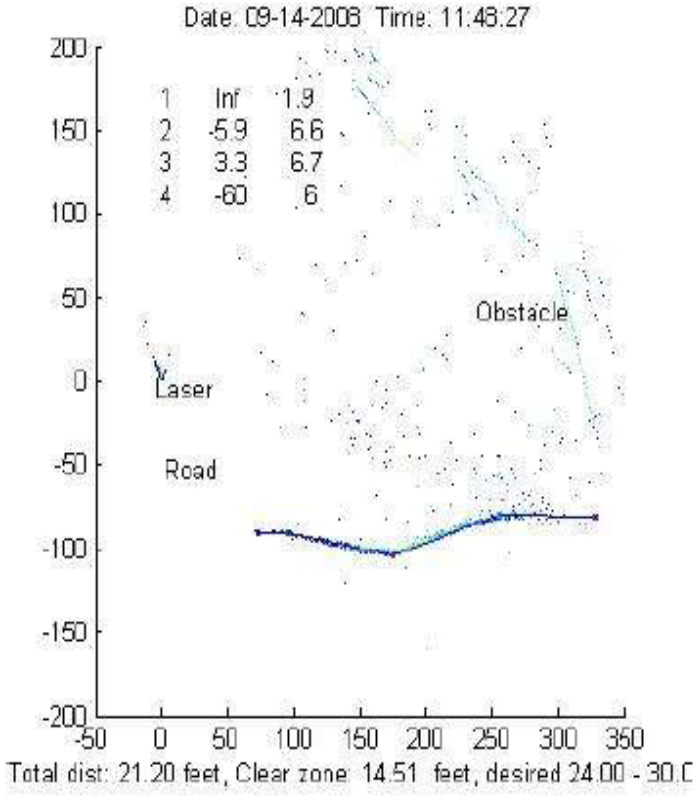
ADT :	1950	HRZL CURVE	No
SPEED LIMIT(mph)	55	TOTAL AVAL DISTANCE(ft)	21.2
DIRECTION	SW	APPLICABLE CLEAR ZONE(ft)	14.51
INSPECTION TIM	11:48:27	DESIRED CLEAR ZONE(ft)	24-30
INSPECTION DATE:	9/14/2008		

Minimum Clearzone Not Met

Colleton SC **188Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

VIDEO -LOG PHOTO

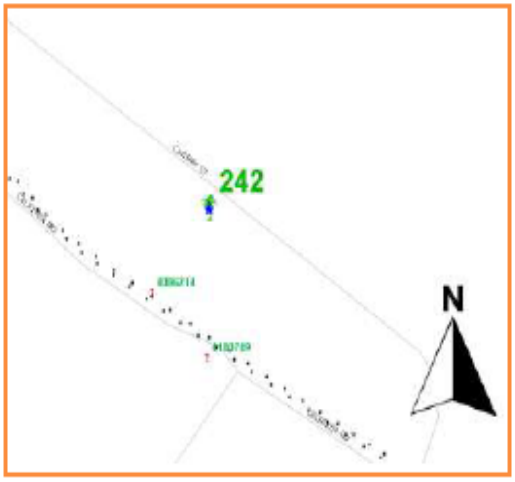
SITE ID:	
NSITE:	188Tree
LONGITUDE:	-80575262
LATITUDE:	32988056
PRIMARY NAME:	Sidney RD
SECONDARY NAME:	State Highway
ROUTE TYPE:	Secondary
LANE	2
SPEED LIMIT (mph):	55
ADT:	1950
DIRECTION:	SW
HRZL CURVE:	No

York SC **242Tree**

SITE DETAILS

SITE ID:	242
NSIT	242Tree
LATITUDE	34961542
LONGITUDE	-80964926
PRIMARY NAME:	Cel River Rd
SECONDARY NAME:	state Rd S46 16
ROUTE TYPE:	Secondary
LANES:	2
SPEED LIMIT (mph):	35
ADT:	7400
HRZL. CURVE	No
DIRECTION:	SW

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
242Tree	4006214	Mailbox	Not Injured
242Tree	4006897	Tree	Not Injured
242Tree	4103749	Mailbox	Possible
242Tree	2006006744	Tree	Possible

CLEARZONE ANALYSIS

ANO: 4006214

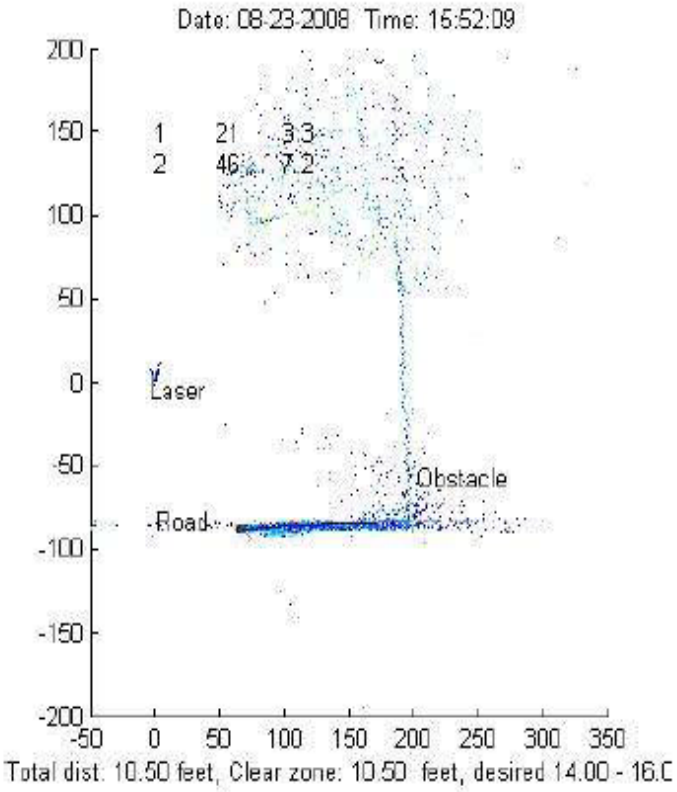
ADT :	7400	HRZL CURVE	No
SPEED LIMIT(mph)	35	TOTAL AVAL DISTANCE(ft)	10.5
DIRECTION	SW	APPLICABLE CLEAR ZONE(ft)	10.5
INSPECTION TIM	15:52:09	DESIRED CLEAR ZONE(ft)	14-16
INSPECTION DATE:	8/24/2008		

Minimum Clearzone Not Met

York SC **242Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	242Tree
LONGITUDE:	-80964926
LATITUDE:	34961000
PRIMARY NAME:	Cel River Rd
SECONDARY NAME:	state Rd S46 16
ROUTE TYPE:	Secondary
LANE	2
SPEED LIMIT (mph):	35
ADT:	7400
DIRECTION:	SW
HRZL CURVE:	No

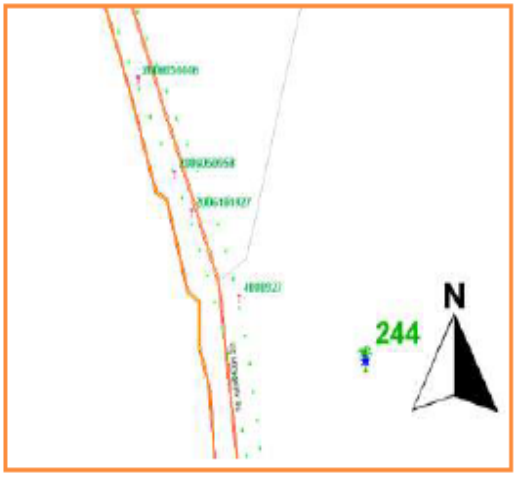
VIDEO -LOG PHOTO

York SC **244Tree**

SITE DETAILS

SITE ID:	244
NSIT	244Tree
LATITUDE	34859957
LONGITUDE	-80932257
PRIMARY NAME:	US Hwy 21
SECONDARY NAME:	
ROUTE TYPE:	US Primary
LANES:	4
SPEED LIMIT (mph):	55
ADT:	6000 over
HRZL. CURVE	No
DIRECTION:	SW

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
244Tree	4080927	Tree	Possible
244Tree	2005008215	Ditch	Not Injured
244Tree	2005012808	Tree	Non-incapacitating
244Tree	2005087072	Tree	Possible
244Tree	2006050958	Tree	Possible
244Tree	2006054446	Tree	Not Injured
244Tree	2006101927	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 2006101927

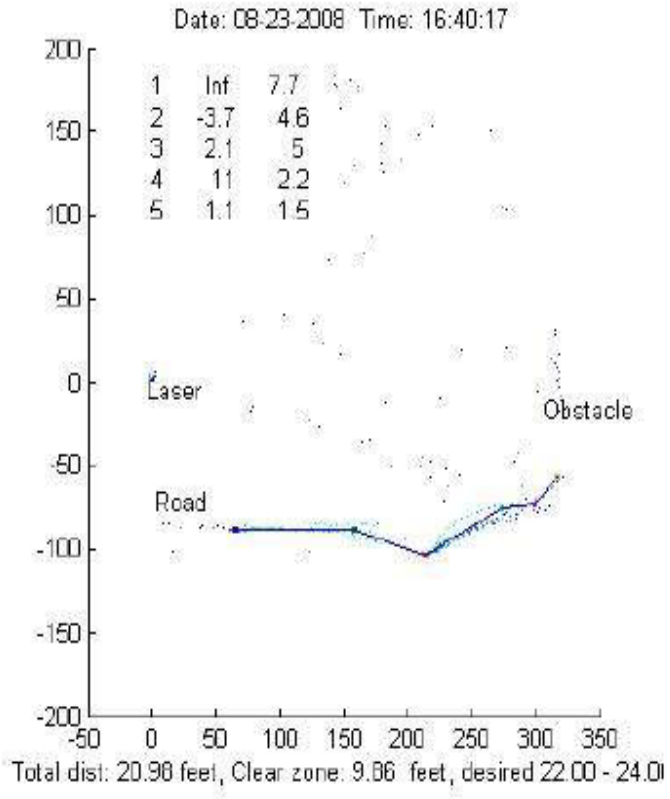
ADT :	6000 over	HRZL CURVE	No
SPEED LIMIT(mph)	55	TOTAL AVAL DISTANCE(ft)	20.98
DIRECTION	SW	APPLICABLE CLEAR ZONE(ft)	9.86
INSPECTION TIM	16:40:17	DESIRED CLEAR ZONE(ft)	22-24
INSPECTION DATE:	8/23/2008		

Minimum Clearzone Not Met

York SC **244Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	244Tree
LONGITUDE:	-80932257
LATITUDE:	34861000
PRIMARY NAME:	US Hwy 21
SECONDARY NAME:	
ROUTE TYPE:	US Primary
LANE	4
SPEED LIMIT (mph):	55
ADT:	6000 over
DIRECTION:	SW
HRZL CURVE:	No

VIDEO -LOG PHOTO

York SC **245Tree**

SITE DETAILS

SITE ID:	245
NSIT	245Tree
LATITUDE	34915916
LONGITUDE	-80982756
PRIMARY NAME:	S Anderson Rd
SECONDARY NAME:	State Hwy 5
ROUTE TYPE:	Interestate
LANES:	4
SPEED LIMIT (mph):	60
ADT:	6000 over
HRZL. CURVE	No
DIRECTION:	SW

GIS:

Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
245Tree	4125868	Tree	Possible
245Tree	2005067703	Tree	Not Injured
245Tree	2005087033	Tree	Possible
245Tree	2006036807	Tree	Not Injured
245Tree	2006107685	Tree	Non-incapacitating
245Tree	2006129602	Tree	Non-incapacitating
245Tree	2006129625	Tree	Possible

CLEARZONE ANALYSIS

ANO: 2006107685

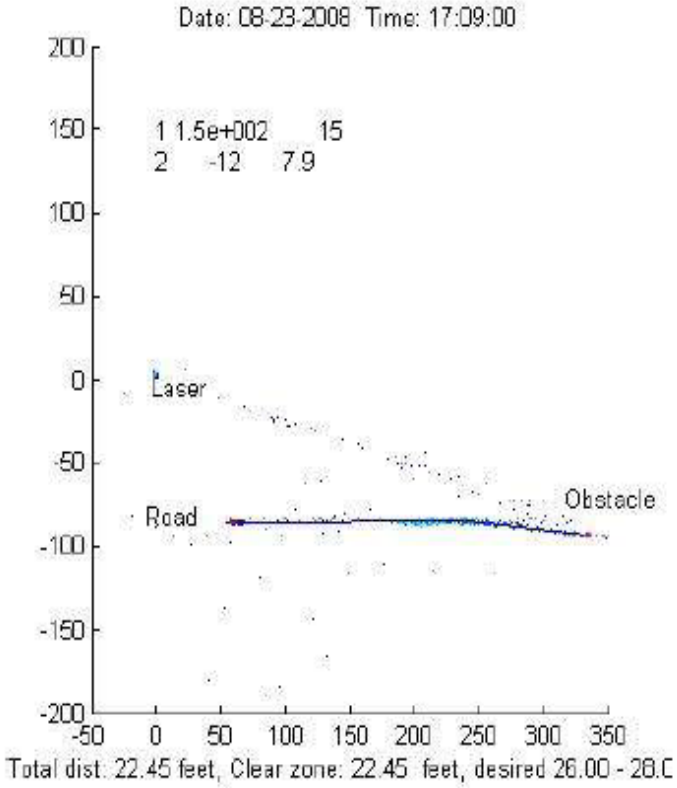
ADT :	6000 over	HRZL CURVE	No
SPEED LIMIT(mph)	60	TOTAL AVAL DISTANCE(ft)	22.45
DIRECTION	SW	APPLICABLE CLEAR ZONE(ft)	22.45
INSPECTION TIM	17:09:00	DESIRED CLEAR ZONE(ft)	26-28
INSPECTION DATE:	8/23/2008		

Minimum Clearzone Not Met

York SC **245Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	245Tree
LONGITUDE:	-80982756
LATITUDE:	34913361
PRIMARY NAME:	S Anderson Rd
SECONDARY NAME:	State Hwy 5
ROUTE TYPE:	Interestate
LANE	4
SPEED LIMIT (mph):	60
ADT:	6000 over
DIRECTION:	SW
HRZL CURVE:	No

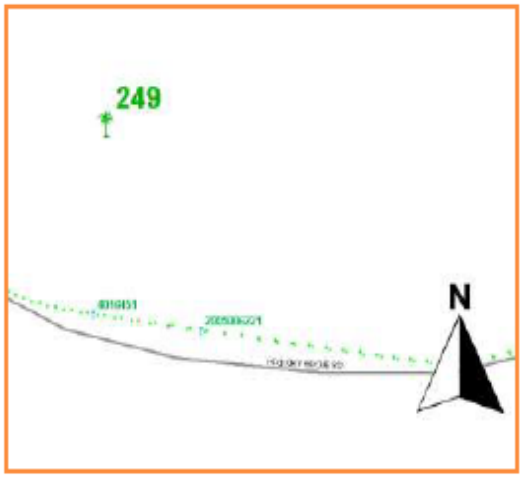
VIDEO -LOG PHOTO

York SC **249Tree**

SITE DETAILS

SITE ID:	249
NSIT	249Tree
LATITUDE	34958487
LONGITUDE	-81390053
PRIMARY NAME:	Hickory Grove Rd
SECONDARY NAME:	State Hwy 211
ROUTE TYPE:	SC Primary
LANES:	2
SPEED LIMIT (mph):	45
ADT:	2300
HRZL. CURVE	No
DIRECTION:	NE

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
249Tree	4016451	Tree	Possible
249Tree	4094216	Equipment	Not Injured
249Tree	2005006221	Ditch	Possible
249Tree	2005012807	Tree	Possible
249Tree	2005037641	Motor Vehicle(In Transport)	Non-incapacitating
249Tree	2005073694	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 2005006221

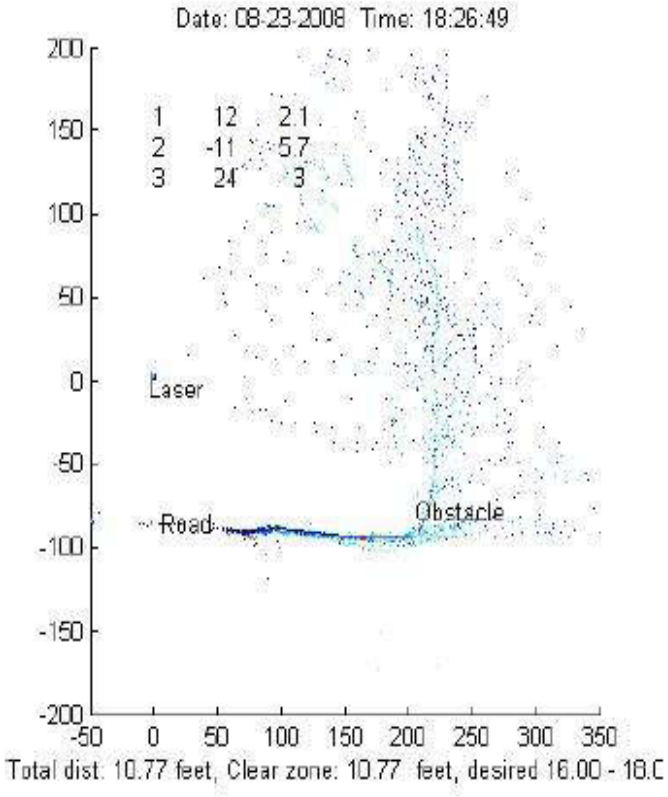
ADT :	2300	HRZL CURVE	No
SPEED LIMIT(mph)	45	TOTAL AVAL DISTANCE(ft)	10.77
DIRECTION	NE	APPLICABLE CLEAR ZONE(ft)	10.77
INSPECTION TIM	18:26:49	DESIRED CLEAR ZONE(ft)	16-18
INSPECTION DATE:	8/23/2008		

Minimum Clearzone Not Met

York SC **249Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

VIDEO -LOG PHOTO

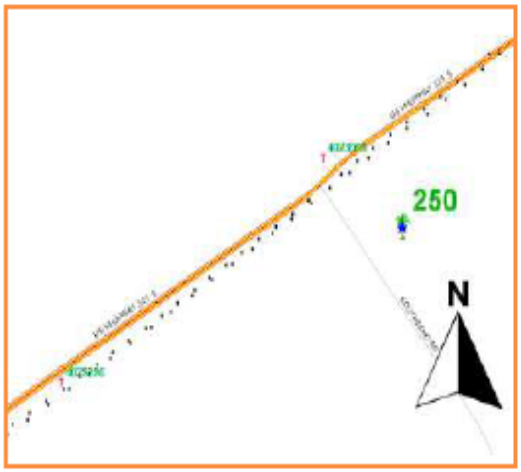
SITE ID:	
NSITE:	249Tree
LONGITUDE:	-81390053
LATITUDE:	34953806
PRIMARY NAME:	Hickory Grove Rd
SECONDARY NAME:	State Hwy 211
ROUTE TYPE:	SC Primary
LANE	2
SPEED LIMIT (mph):	45
ADT:	2300
DIRECTION:	NE
HRZL CURVE:	No

York SC **250Tree**

SITE DETAILS

SITE ID:	250
NSIT	250Tree
LATITUDE	35060112
LONGITUDE	-81238690
PRIMARY NAME:	US 321S
SECONDARY NAME:	
ROUTE TYPE:	US Primary
LANES:	2
SPEED LIMIT (mph):	45
ADT:	6400
HRZL. CURVE	No
DIRECTION:	SW

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
250Tree	4023555	Tree	Non-incapacitating
250Tree	4029296	Tree	Not Injured
250Tree	2005029902	Tree	Possible
250Tree	2005150040	Tree	Not Injured
250Tree	2005153189	Tree	Incapacitating
250Tree	2006137957	Ditch	Not Injured

CLEARZONE ANALYSIS

ANO: 4023555

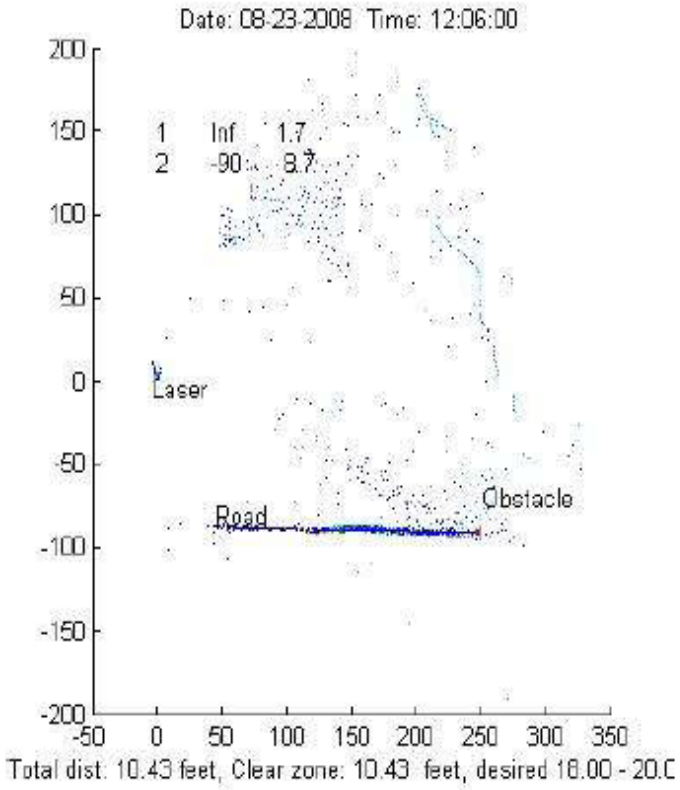
ADT :	6400	HRZL CURVE	No
SPEED LIMIT(mph)	45	TOTAL AVAL DISTANCE(ft)	10.43
DIRECTION	SW	APPLICABLE CLEAR ZONE(ft)	10.43
INSPECTION TIM	12:06:00	DESIRED CLEAR ZONE(ft)	18-20
INSPECTION DATE:	8/23/2008		

Minimum Clearzone Not Met

York SC **250Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	250Tree
LONGITUDE:	-81238690
LATITUDE:	35060722
PRIMARY NAME:	US 321S
SECONDARY NAME:	
ROUTE TYPE:	US Primary
LANE	2
SPEED LIMIT (mph):	45
ADT:	6400
DIRECTION:	SW
HRZL CURVE:	No

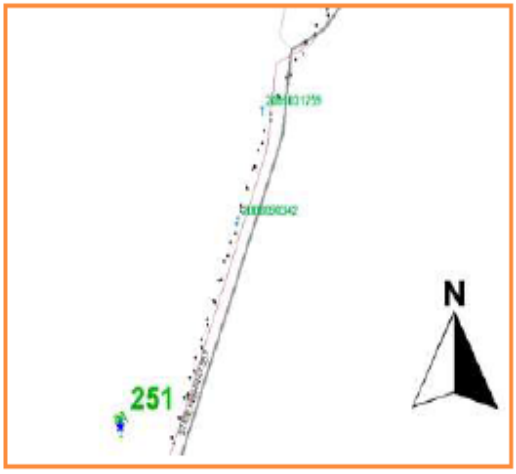
VIDEO -LOG PHOTO

York SC **251Tree**

SITE DETAILS

SITE ID:	251
NSIT	251Tree
LATITUDE	35115573
LONGITUDE	-81145166
PRIMARY NAME:	State Hwy 557
SECONDARY NAME:	
ROUTE TYPE:	SC Primary
LANES:	2
SPEED LIMIT (mph):	55
ADT:	1500-6000
HRZL. CURVE	No
DIRECTION:	NW

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
251Tree	4093422	Tree	Possible
251Tree	4123766	Fence	Not Injured
251Tree	2005031759	Culvert	Not Injured
251Tree	2006002514	Tree	Possible
251Tree	2006013721	Utility Pole	Possible
251Tree	2006090342	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 2006090342

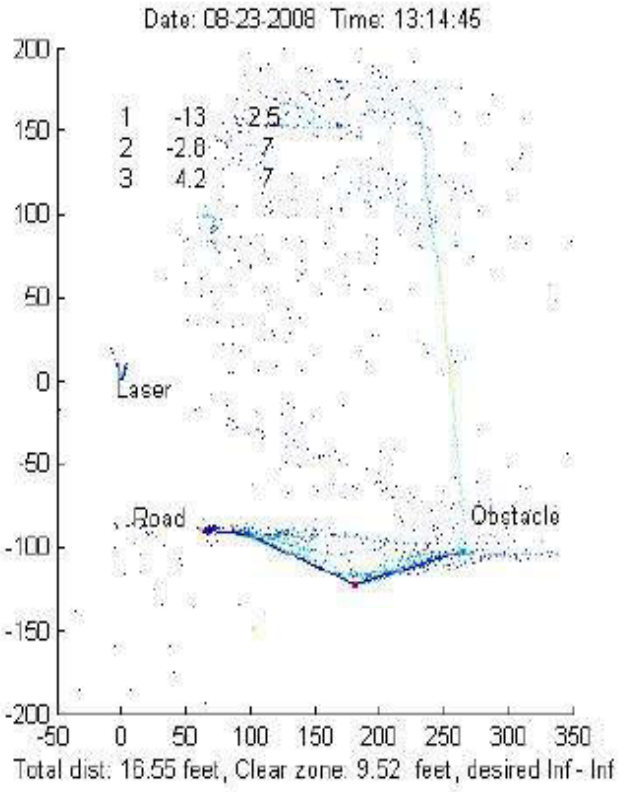
ADT :	1500-6000	HRZL CURVE	No
SPEED LIMIT(mph)	55	TOTAL AVAL DISTANCE(ft)	16.55
DIRECTION	NW	APPLICABLE CLEAR ZONE(ft)	9.52
INSPECTION TIM	13:14:46	DESIRED CLEAR ZONE(ft)	9999
INSPECTION DATE:	8/24/2008		

Minimum Clearzone Not Met

York SC **251Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	251Tree
LONGITUDE:	-81145166
LATITUDE:	35117417
PRIMARY NAME:	State Hwy 557
SECONDARY NAME:	
ROUTE TYPE:	SC Primary
LANE	2
SPEED LIMIT (mph):	55
ADT:	1500-6000
DIRECTION:	NW
HRZL CURVE:	No

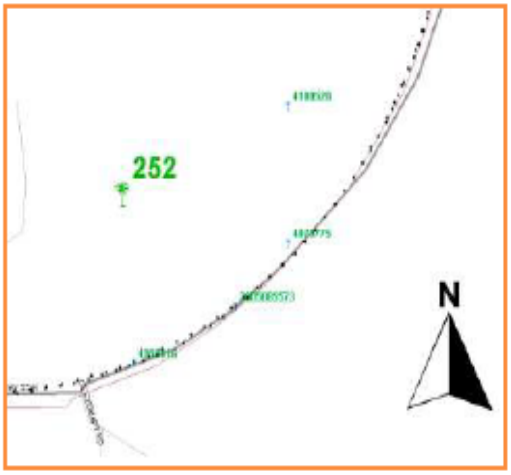
VIDEO -LOG PHOTO

York SC **252Tree**

SITE DETAILS

SITE ID:	252
NSIT	252Tree
LATITUDE	35094834
LONGITUDE	-81337000
PRIMARY NAME:	State Hwy 55w
SECONDARY NAME:	
ROUTE TYPE:	SC Primary
LANES:	2
SPEED LIMIT (mph):	45
ADT:	1400
HRZL. CURVE	Yes
DIRECTION:	E

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
252Tree	4050416	Tree	Not Injured
252Tree	4070775	Tree	Not Injured
252Tree	4100528	Tree	Possible
252Tree	2005085573	Enbankment	Not Injured
252Tree	2006005686	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 4050416

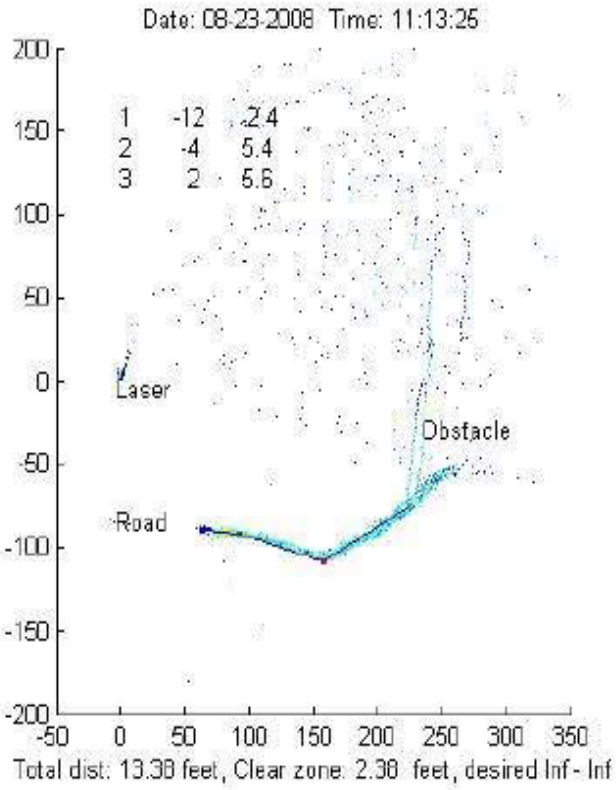
ADT :	1400	HRZL CURVE	Yes
SPEED LIMIT(mph)	45	TOTAL AVAL DISTANCE(ft)	13.38
DIRECTION	E	APPLICABLE CLEAR ZONE(ft)	2.38
INSPECTION TIM	11:13:25	DESIRED CLEAR ZONE(ft)	9999- 9999
INSPECTION DATE:	8/24/2008		

Minimum Clearzone Not Met

York SC **252Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	252Tree
LONGITUDE:	-81337000
LATITUDE:	35088417
PRIMARY NAME:	State Hwy 55w
SECONDARY NAME:	
ROUTE TYPE:	SC Primary
LANE	2
SPEED LIMIT (mph):	45
ADT:	1400
DIRECTION:	E
HRZL CURVE:	Yes

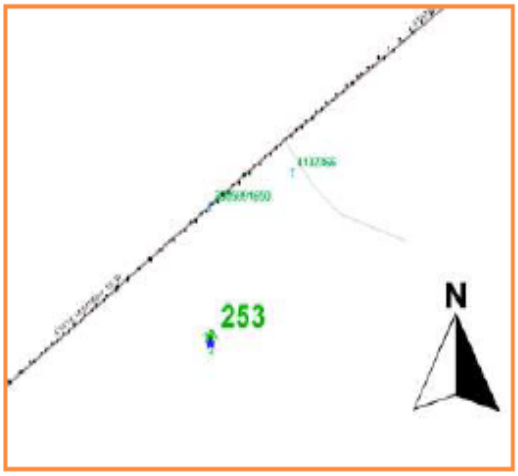
VIDEO -LOG PHOTO

York SC **253Tree**

SITE DETAILS

SITE ID:	253
NSIT	253Tree
LATITUDE	35128607
LONGITUDE	-81259758
PRIMARY NAME:	US Hwy 17
SECONDARY NAME:	
ROUTE TYPE:	SC Primary
LANES:	2
SPEED LIMIT (mph):	45
ADT:	4100
HRZL. CURVE	Yes
DIRECTION:	NE

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
253Tree	4071486	Tree	Not Injured
253Tree	4132366	Tree	Possible
253Tree	2005091650	Tree	Possible
253Tree	2005118591	Fence	Possible
253Tree	2006147032	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 2005091650

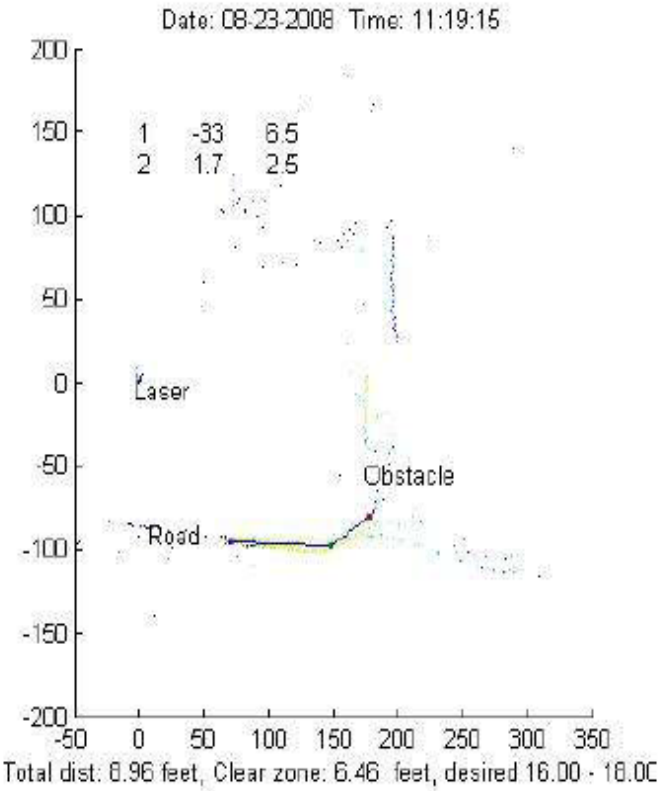
ADT :	4100	HRZL CURVE	Yes
SPEED LIMIT(mph)	45	TOTAL AVAL DISTANCE(ft)	8.96
DIRECTION	NE	APPLICABLE CLEAR ZONE(ft)	6.45
INSPECTION TIM	11:19:15	DESIRED CLEAR ZONE(ft)	16-18
INSPECTION DATE:	8/24/2008		

Minimum Clearzone Not Met

York SC **253Tree**

ANO

LASER MEASUREMENT:



Total dist: 8.96 feet, Clear zone: 6.46 feet, desired 16.00 - 18.00

SITE DETAILS:

SITE ID:	
NSITE:	253Tree
LONGITUDE:	-81259758
LATITUDE:	35130306
PRIMARY NAME:	US Hwy 17
SECONDARY NAME:	
ROUTE TYPE:	SC Primary
LANE	2
SPEED LIMIT (mph):	45
ADT:	4100
DIRECTION:	NE
HRZL CURVE:	Yes

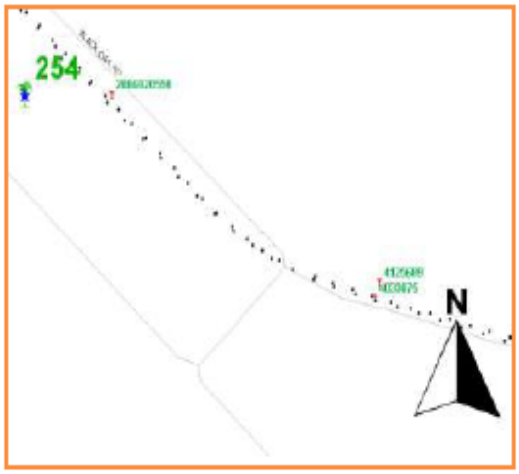
VIDEO -LOG PHOTO

Berkeley SC **254Tree**

SITE DETAILS

SITE ID:	254
NSIT	254Tree
LATITUDE	33310705
LONGITUDE	-79978606
PRIMARY NAME:	Black Oak Rd
SECONDARY NAME:	
ROUTE TYPE:	Secondary
LANES:	2
SPEED LIMIT (mph):	35
ADT:	3700
HRZL. CURVE	No
DIRECTION:	SE

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
254Tree	4033075	Tree	Not Injured
254Tree	4125689	Tree	Not Injured
254Tree	4125862	Tree	Not Injured
254Tree	4131624	Tree	Not Injured
254Tree	2005137785	Tree	Possible
254Tree	2006028550	Tree	Possible

CLEARZONE ANALYSIS

ANO: 4033075

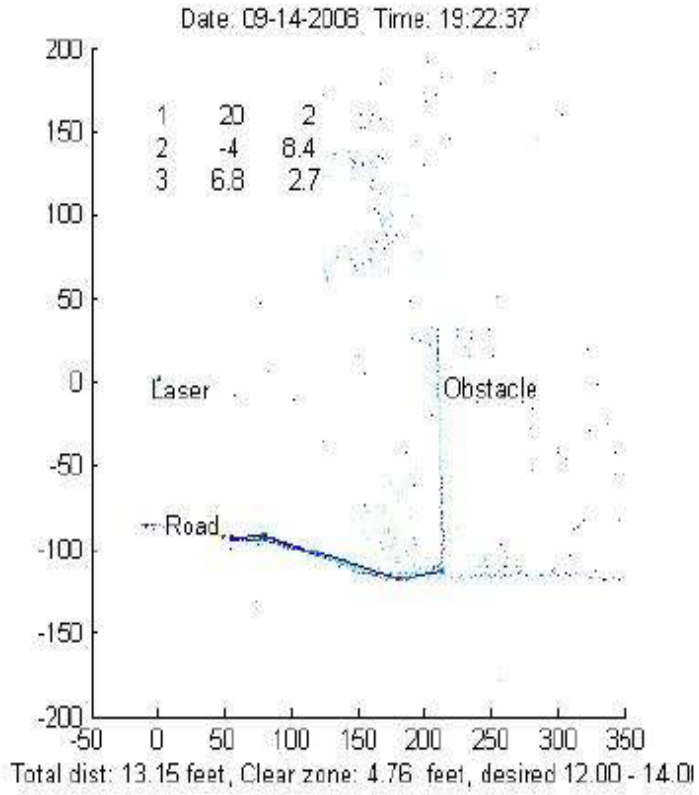
ADT :	3700	HRZL CURVE	No
SPEED LIMIT(mph)	35	TOTAL AVAL DISTANCE(ft)	13.15
DIRECTION	SE	APPLICABLE CLEAR ZONE(ft)	4.76
INSPECTION TIM	19:22:37	DESIRED CLEAR ZONE(ft)	12-14
INSPECTION DATE:	9/14/2008		

Minimum Clearzone Not Met

Berkeley SC **254Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	254Tree
LONGITUDE:	-79978606
LATITUDE:	33308889
PRIMARY NAME:	Black Oak Rd
SECONDARY NAME:	
ROUTE TYPE:	Secondary
LANE	2
SPEED LIMIT (mph):	35
ADT:	3700
DIRECTION:	SE
HRZL CURVE:	No

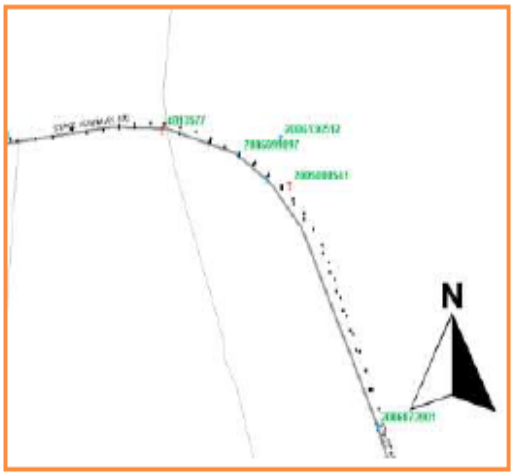
VIDEO -LOG PHOTO

Berkeley SC **256Tree**

SITE DETAILS

SITE ID:	256
NSIT	256Tree
LATITUDE	33131541
LONGITUDE	-79813550
PRIMARY NAME:	State Hwy 402
SECONDARY NAME:	
ROUTE TYPE:	SC Primary
LANES:	2
SPEED LIMIT (mph):	45
ADT:	2600
HRZL. CURVE	No
DIRECTION:	SW

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
256Tree	2005020400	Tree	Not Injured
256Tree	2006073901	Tree	Possible
256Tree	2006099097	Tree	Possible
256Tree	2006136512	Tree	Not Injured
256Tree	2006146782	Tree	Possible
256Tree	2006153151	Tree	Possible

CLEARZONE ANALYSIS

ANO: 2005020400

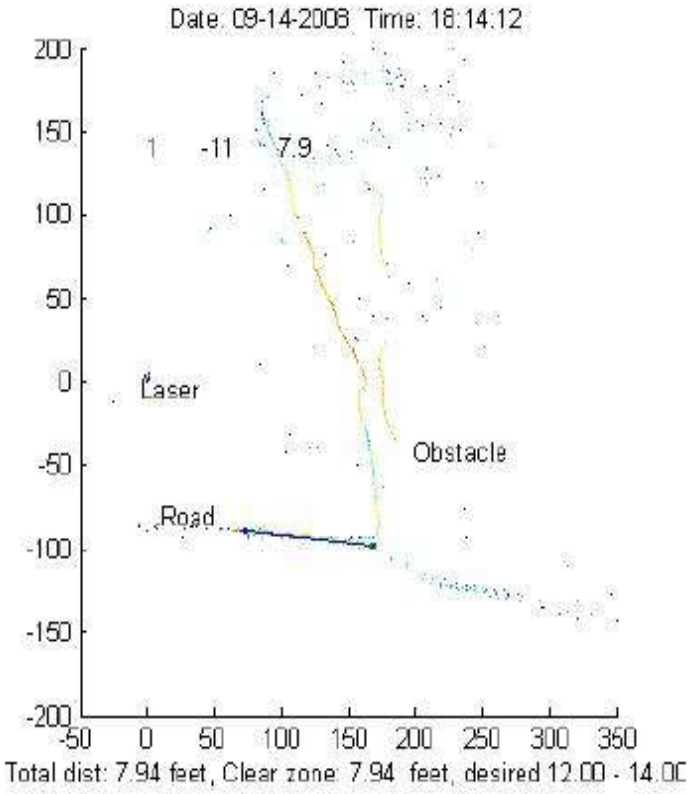
ADT :	2600	HRZL CURVE	No
SPEED LIMIT(mph)	45	TOTAL AVAL DISTANCE(ft)	7.94
DIRECTION	SW	APPLICABLE CLEAR ZONE(ft)	7.94
INSPECTION TIM	18:14:12	DESIRED CLEAR ZONE(ft)	12-14
INSPECTION DATE:	9/14/2008		

Minimum Clearzone Not Met

Berkeley SC **256Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	256Tree
LONGITUDE:	-79813550
LATITUDE:	33135583
PRIMARY NAME:	State Hwy 402
SECONDARY NAME:	
ROUTE TYPE:	SC Primary
LANE	2
SPEED LIMIT (mph):	45
ADT:	2600
DIRECTION:	SW
HRZL CURVE:	No

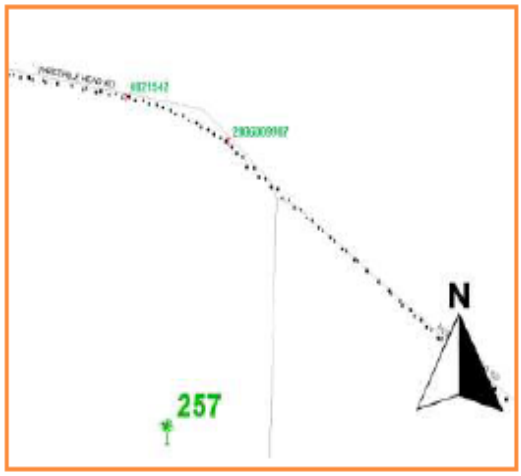
VIDEO -LOG PHOTO

Berkeley SC **257Tree**

SITE DETAILS

SITE ID:	257
NSIT	257Tree
LATITUDE	33159044
LONGITUDE	-79846883
PRIMARY NAME:	Witherbe Rd
SECONDARY NAME:	
ROUTE TYPE:	Secondary
LANES:	2
SPEED LIMIT (mph):	45
ADT:	400
HRZL. CURVE	Yes
DIRECTION:	SE

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
257Tree	4015555	Tree	Not Injured
257Tree	4021542	Tree	Possible
257Tree	4072669	Tree	Not Injured
257Tree	2005029876	Tree	Possible
257Tree	2006009987	Tree	Not Injured
257Tree	2006062985	Tree	Possible

CLEARZONE ANALYSIS

ANO: 2006009987

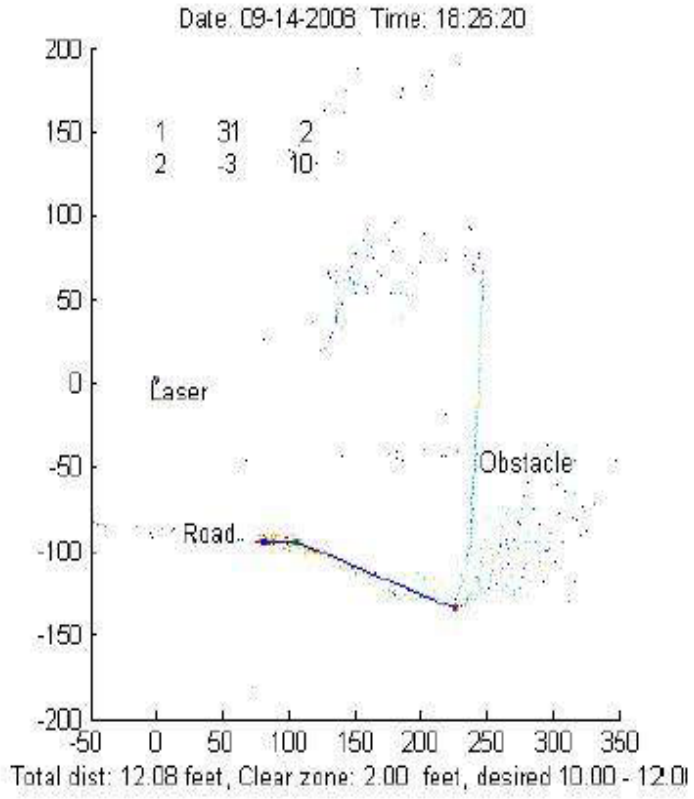
ADT :	400	HRZL CURVE	Yes
SPEED LIMIT(mph)	45	TOTAL AVAL DISTANCE(ft)	12.08
DIRECTION	SE	APPLICABLE CLEAR ZONE(ft)	2
INSPECTION TIM	18:26:20	DESIRED CLEAR ZONE(ft)	10-12
INSPECTION DATE:	9/14/2008		

Minimum Clearzone Not Met

Berkeley SC **257Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	257Tree
LONGITUDE:	-79846883
LATITUDE:	33189361
PRIMARY NAME:	Witherbe Rd
SECONDARY NAME:	
ROUTE TYPE:	Secondary
LANE	2
SPEED LIMIT (mph):	45
ADT:	400
DIRECTION:	SE
HRZL CURVE:	Yes

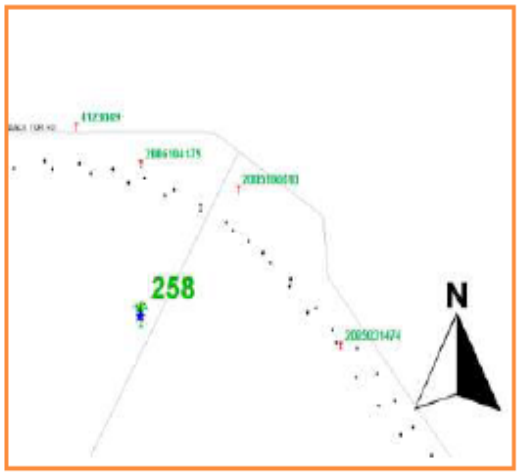
VIDEO -LOG PHOTO

Berkeley SC **258Tree**

SITE DETAILS

SITE ID:	258
NSIT	258Tree
LATITUDE	33157419
LONGITUDE	-80067925
PRIMARY NAME:	Black thumb Rd
SECONDARY NAME:	
ROUTE TYPE:	Secondary
LANES:	2
SPEED LIMIT (mph):	35
ADT:	2600
HRZL. CURVE	Yes
DIRECTION:	NW

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
258Tree	4123049	Tree	Possible
258Tree	2005031474	Ditch	Not Injured
258Tree	2005106618	Tree	Possible
258Tree	2006104179	Tree	Possible
258Tree	2006143964	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 2005106618

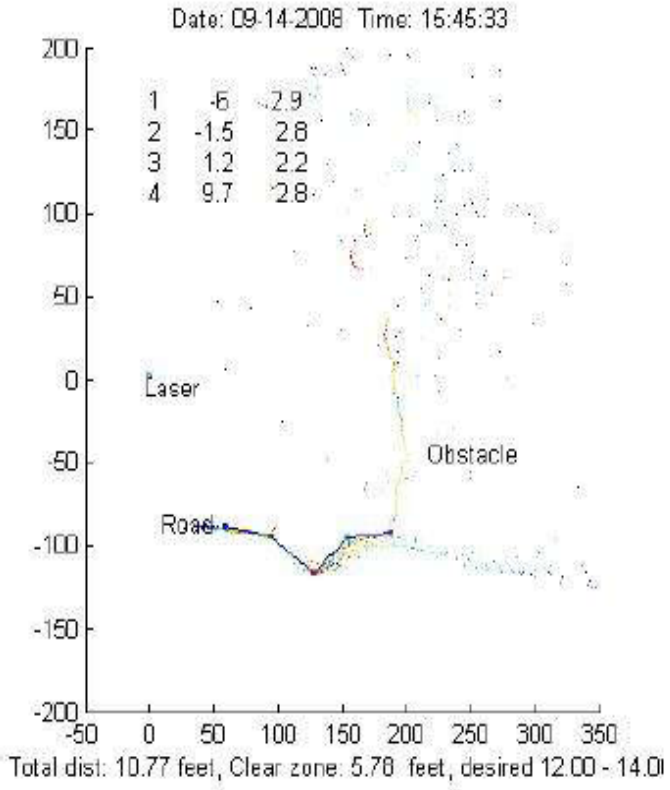
ADT :	2600	HRZL CURVE	Yes
SPEED LIMIT(mph)	35	TOTAL AVAL DISTANCE(ft)	10.77
DIRECTION	NW	APPLICABLE CLEAR ZONE(ft)	5.78
INSPECTION TIM	15:45:33	DESIRED CLEAR ZONE(ft)	12-14
INSPECTION DATE:	9/14/2008		

Minimum Clearzone Not Met

Berkeley SC **258Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	258Tree
LONGITUDE:	-80067925
LATITUDE:	33157972
PRIMARY NAME:	Black thumb Rd
SECONDARY NAME:	
ROUTE TYPE:	Secondary
LANE	2
SPEED LIMIT (mph):	35
ADT:	2600
DIRECTION:	NW
HRZL CURVE:	Yes

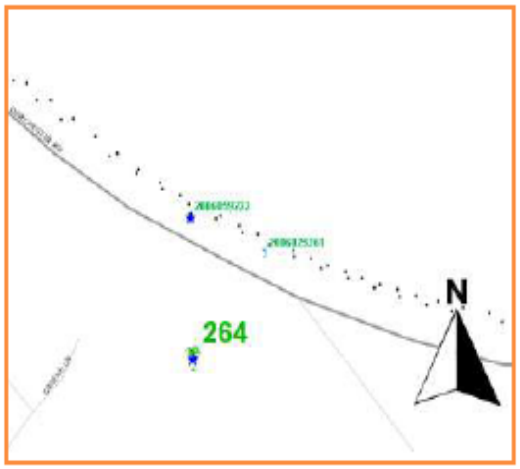
VIDEO -LOG PHOTO

Dorchester SC **264Tree**

SITE DETAILS

SITE ID:	264
NSIT	264Tree
LATITUDE	32952358
LONGITUDE	-80174537
PRIMARY NAME:	Dorchester Rd
SECONDARY NAME:	State Hwy 642
ROUTE TYPE:	SC Primary
LANES:	2
SPEED LIMIT (mph):	45
ADT:	23000
HRZL. CURVE	Yes
DIRECTION:	SE

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
264Tree	4026140	Tree	Not Injured
264Tree	4032739	Tree	Possible
264Tree	4123186	Tree	Not Injured
264Tree	2005041150	Tree	Possible
264Tree	2006005563	Tree	Non-incapacitating
264Tree	2006059222	Tree	Possible
264Tree	2006065606	Other Non Collition	Not Injured
264Tree	2006104618	Tree	Not Injured
264Tree	2006154423	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 2006059222

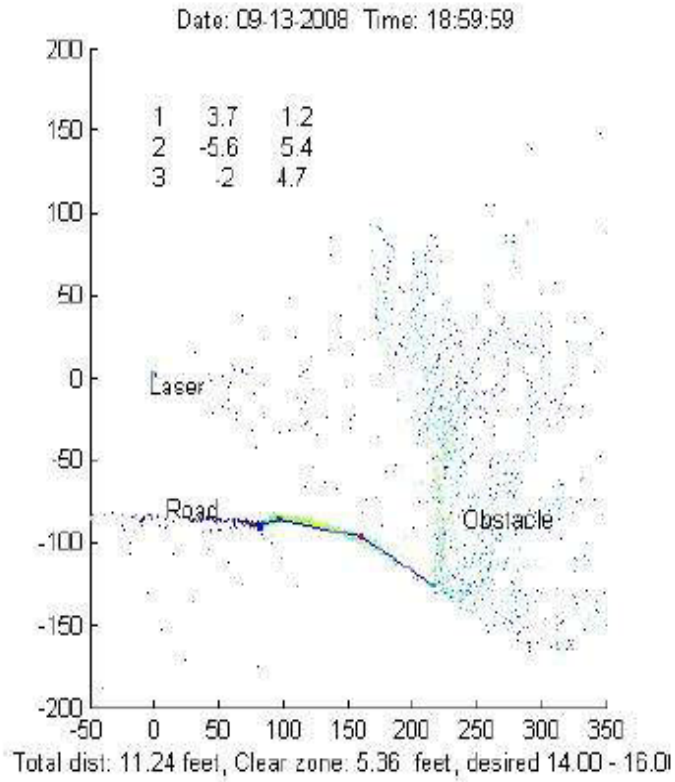
ADT :	23000	HRZL CURVE	Yes
SPEED LIMIT(mph)	45	TOTAL AVAL DISTANCE(ft)	11.24
DIRECTION	SE	APPLICABLE CLEAR ZONE(ft)	5.36
INSPECTION TIM	18:59:59	DESIRED CLEAR ZONE(ft)	14-16
INSPECTION DATE:	9/13/2008		

Minimum Clearzone Not Met

Dorchester SC **264Tree**

ANO

LASER MEASUREMENT:



Total dist: 11.24 feet, Clear zone: 5.36 feet, desired 14.00 - 16.01

SITE DETAILS:

SITE ID:	
NSITE:	264Tree
LONGITUDE:	-80174537
LATITUDE:	32953111
PRIMARY NAME:	Dorchester Rd
SECONDARY NAME:	State Hwy 642
ROUTE TYPE:	SC Primary
LANE	2
SPEED LIMIT (mph):	45
ADT:	23000
DIRECTION:	SE
HRZL CURVE:	Yes

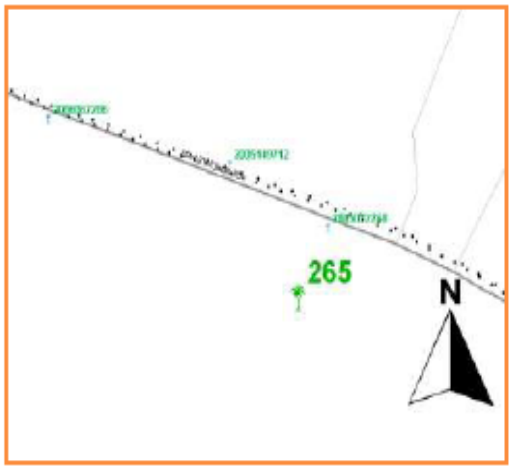
VIDEO -LOG PHOTO

Dorchester SC **265Tree**

SITE DETAILS

SITE ID:	265
NSIT	265Tree
LATITUDE	32947777
LONGITUDE	-80205251
PRIMARY NAME:	Ashley River Rd
SECONDARY NAME:	State Hwy 61
ROUTE TYPE:	SC Primary
LANES:	2
SPEED LIMIT (mph):	45
ADT:	8800
HRZL. CURVE	No
DIRECTION:	NW

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
265Tree	4019706	Tree	Not Injured
265Tree	4038745	Tree	Not Injured
265Tree	4042706	Tree	Incapacitating
265Tree	4051127	Tree	Not Injured
265Tree	4071439	Tree	Not Injured
265Tree	4147691	Tree	Not Injured
265Tree	4150771	Tree	Possible
265Tree	2005014532	Animal(Dear Only)	Not Injured
265Tree	2005072268	Tree	Possible
265Tree	2005078035	Tree	Not Injured
265Tree	2005078664	Tree	Not Injured
265Tree	2005137780	Tree	Not Injured
265Tree	2005139480	Tree	Not Injured
265Tree	2005149712	Tree	Possible
265Tree	2006002333	Tree	Not Injured
265Tree	2006013327	Tree	Not Injured
265Tree	2006067206	Tree	Not Injured
265Tree	2006124438	Tree	Not Injured
265Tree	2006143318	Tree	Possible

CLEARZONE ANALYSIS

Dorchester SC **265Tree**

ANO: 20050722G8

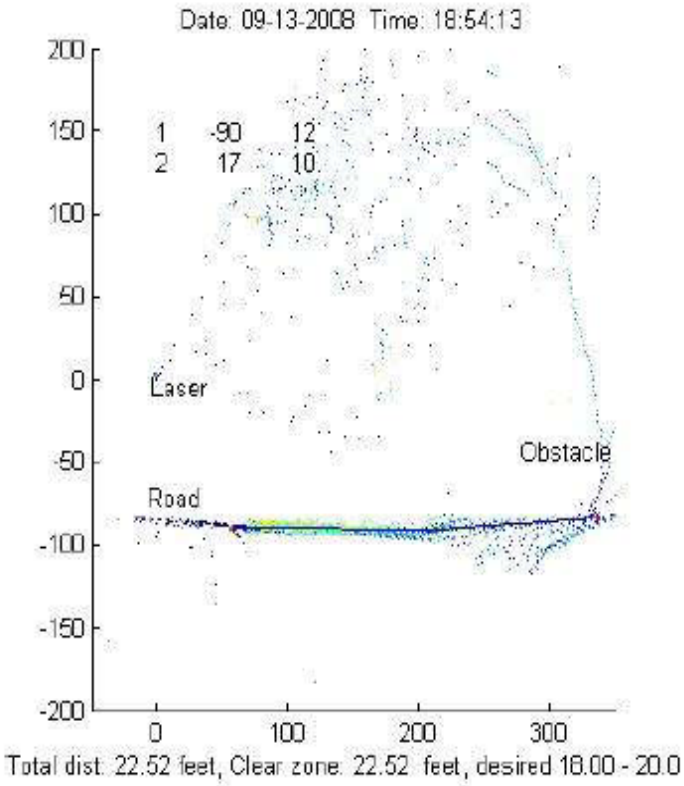
ADT :	8800	HRZL CURVE	No
SPEED LIMIT(mph)	45	TOTAL AVAL DISTANCE(ft)	22.52
DIRECTION	NW	APPLICABLE CLEAR ZONE(ft)	22.52
INSPECTION TIM	18:54:13	DESIRED CLEAR ZONE(ft)	18-20
INSPECTION DATE:	9/13/2008		

Sufficient Clearzone

Dorchester SC **265Tree**

ANO

LASER MEASUREMENT:

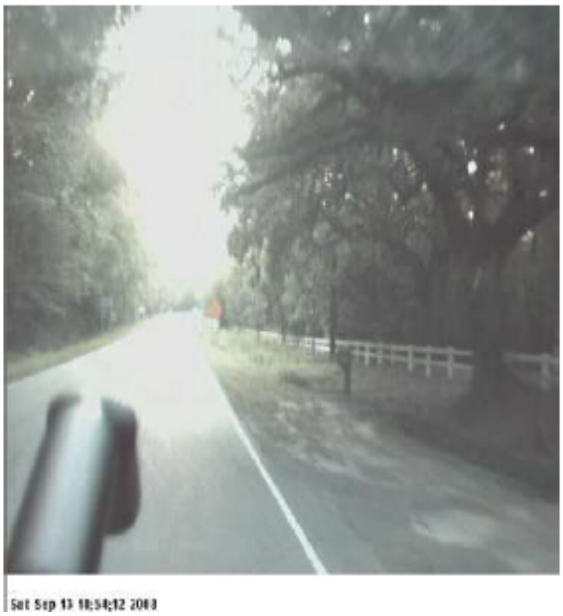


Total dist: 22.52 feet, Clear zone: 22.52 feet, desired 18.00 - 20.0

SITE DETAILS:

SITE ID:	
NSITE:	265Tree
LONGITUDE:	-80205251
LATITUDE:	32945306
PRIMARY NAME:	Ashley River Rd
SECONDARY NAME:	State Hwy 61
ROUTE TYPE:	SC Primary
LANE	2
SPEED LIMIT (mph):	45
ADT:	8800
DIRECTION:	NW
HRZL CURVE:	No

VIDEO -LOG PHOTO

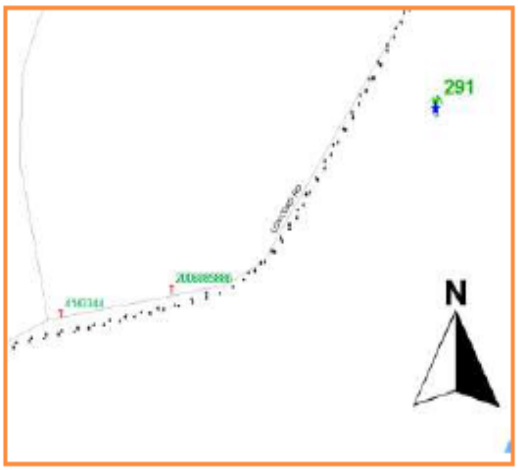


Cherokee SC **291Tree**

SITE DETAILS

SITE ID:	291
NSIT	291Tree
LATITUDE	35118719
LONGITUDE	-81638540
PRIMARY NAME:	Concord Rd
SECONDARY NAME:	State Hwy S11 71
ROUTE TYPE:	Secondary
LANES:	2
SPEED LIMIT (mph):	40
ADT:	750
HRZL. CURVE	Yes
DIRECTION:	SE

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
291Tree	4143344	Ditch	Possible
291Tree	2005042346	Tree	Possible
291Tree	2005115133	Tree	Not Injured
291Tree	2006085886	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 2006085886

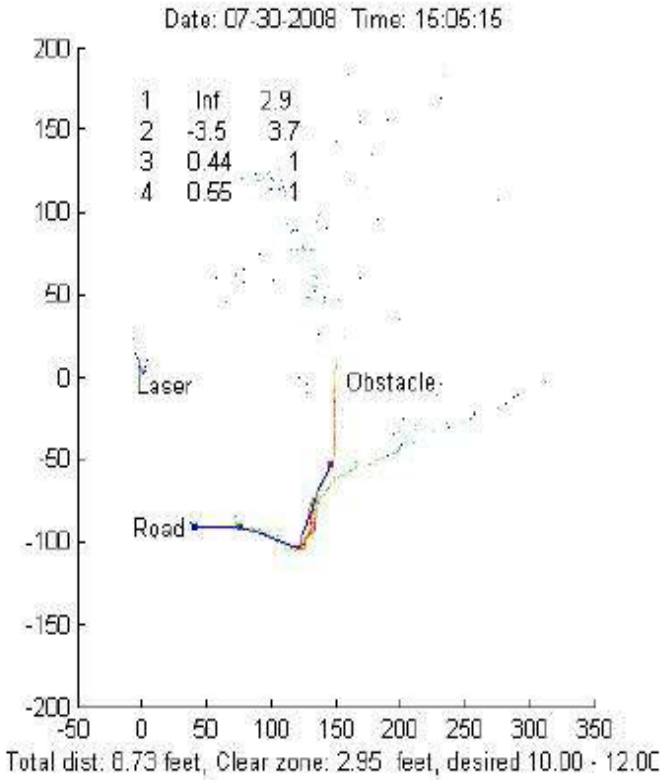
ADT :	750	HRZL CURVE	Yes
SPEED LIMIT(mph)	40	TOTAL AVAL DISTANCE(ft)	8.73
DIRECTION	SE	APPLICABLE CLEAR ZONE(ft)	2.95
INSPECTION TIM	15:05:15	DESIRED CLEAR ZONE(ft)	10-12
INSPECTION DATE:	7/30/2008		

Minimum Clearzone Not Met

Cherokee SC **291Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	291Tree
LONGITUDE:	-81638540
LATITUDE:	35117111
PRIMARY NAME:	Concord Rd
SECONDARY NAME:	State Hwy S11 71
ROUTE TYPE:	Secondary
LANE	2
SPEED LIMIT (mph):	40
ADT:	750
DIRECTION:	SE
HRZL CURVE:	Yes

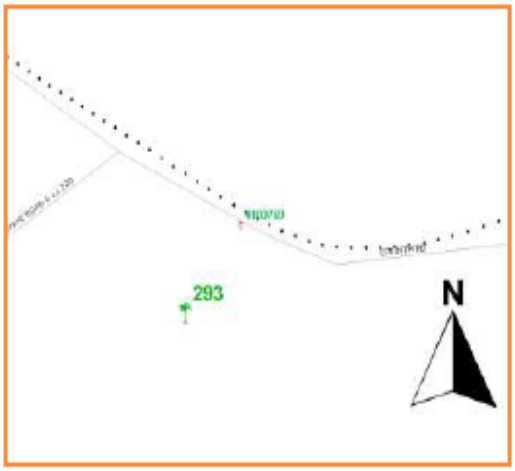
VIDEO -LOG PHOTO

Cherokee SC **293Tree**

SITE DETAILS

SITE ID:	293
NSIT	293Tree
LATITUDE	35005883
LONGITUDE	-81649777
PRIMARY NAME:	Corinth Rd
SECONDARY NAME:	State Rd S 11 54
ROUTE TYPE:	Secondary
LANES:	2
SPEED LIMIT (mph):	40
ADT:	500
HRZL. CURVE	Yes
DIRECTION:	SW

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
293Tree	4022516	Tree	Not Injured
293Tree	4079209	Tree	Not Injured
293Tree	4103769	Tree	Not Injured
293Tree	4129183	Tree	Incapacitating
293Tree	2005050727	Tree	Not Injured
293Tree	2006066380	Motor Vehicle(In Transport)	Not Injured

CLEARZONE ANALYSIS

ANO: 4103769

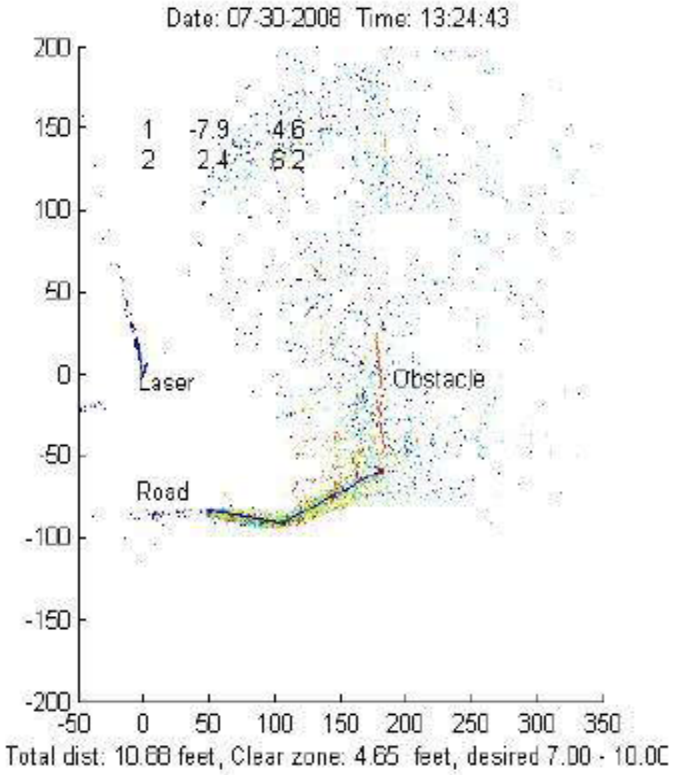
ADT :	500	HRZL CURVE	Yes
SPEED LIMIT(mph)	40	TOTAL AVAL DISTANCE(ft)	10.88
DIRECTION	SW	APPLICABLE CLEAR ZONE(ft)	4.65
INSPECTION TIM	13:24:43	DESIRED CLEAR ZONE(ft)	7-10
INSPECTION DATE:	7/30/2008		

Minimum Clearzone Not Met

Cherokee SC **293Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	293Tree
LONGITUDE:	-81649777
LATITUDE:	35007667
PRIMARY NAME:	Corinth Rd
SECONDARY NAME:	State Rd S 11 54
ROUTE TYPE:	Secondary
LANE	2
SPEED LIMIT (mph):	40
ADT:	500
DIRECTION:	SW
HRZL CURVE:	Yes

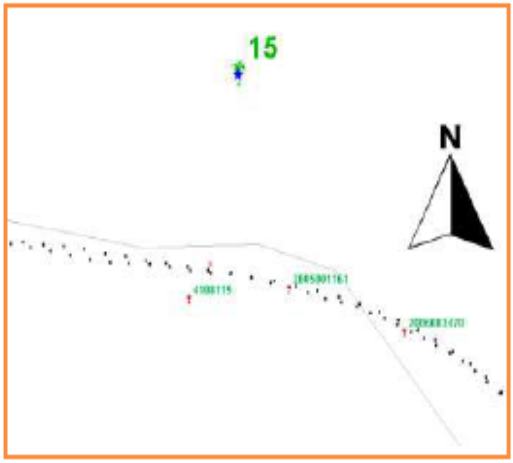
VIDEO -LOG PHOTO

Lexington SC **15Tree**

SITE DETAILS

SITE ID:	15
NSIT	15Tree
LATITUDE	34032652
LONGITUDE	-81161711
PRIMARY NAME:	Corley Mill RD
SECONDARY NAME:	State Road S 32 68
ROUTE TYPE:	Secondary
LANES:	2
SPEED LIMIT (mph):	35
ADT:	5800
HRZL. CURVE	Yes
DIRECTION:	NW

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
15Tree	4015584	Tree	Possible
15Tree	4026927	Enbankment	Not Injured
15Tree	4087417	Tree	Possible
15Tree	4108119	Bridge Rail	Possible
15Tree	4116233	Tree	Possible
15Tree	2005001161	Tree	Not Injured
15Tree	2005030859	Tree	Not Injured
15Tree	2005085903	Tree	Possible
15Tree	2005155699	Tree	Possible
15Tree	2006083470	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 2005001161

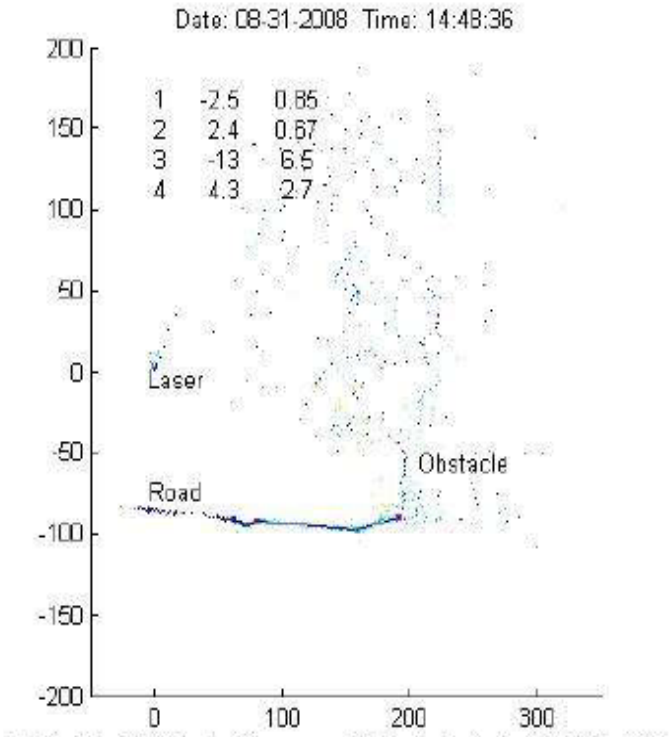
ADT :	5800	HRZL CURVE	Yes
SPEED LIMIT(mph)	35	TOTAL AVAL DISTANCE(ft)	10.8
DIRECTION	NW	APPLICABLE CLEAR ZONE(ft)	9.27
INSPECTION TIM	14:48:35	DESIRED CLEAR ZONE(ft)	12-14
INSPECTION DATE:	8/31/2008		

Minimum Clearzone Not Met

Lexington SC **15Tree**

ANO

LASER MEASUREMENT:



Total dist: 10.80 feet, Clear zone: 9.27 feet, desired 12.00 - 14.0

SITE DETAILS:

SITE ID:	
NSITE:	15Tree
LONGITUDE:	-81161711
LATITUDE:	34031000
PRIMARY NAME:	Corley Mill RD
SECONDARY NAME:	State Road S 32 68
ROUTE TYPE:	Secondary
LANE	2
SPEED LIMIT (mph):	35
ADT:	5800
DIRECTION:	NW
HRZL CURVE:	Yes

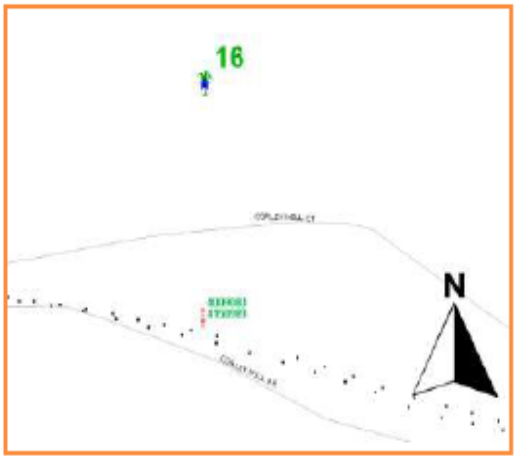
VIDEO -LOG PHOTO

Lexington SC **16Tree**

SITE DETAILS

SITE ID:	16
NSIT	16Tree
LATITUDE	34033956
LONGITUDE	-81206347
PRIMARY NAME:	Corley Mill RD
SECONDARY NAME:	State Road S 32 68
ROUTE TYPE:	Secondary
LANES:	2
SPEED LIMIT (mph):	45
ADT:	2900
HRZL. CURVE	No
DIRECTION:	NW

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
16Tree	4009080	Tree	Not Injured
16Tree	4150989	Tree	Possible
16Tree	2006105800	Tree	Possible
16Tree	2006113460	Tree	Non-incapacitating

CLEARZONE ANALYSIS

ANO: 4150989

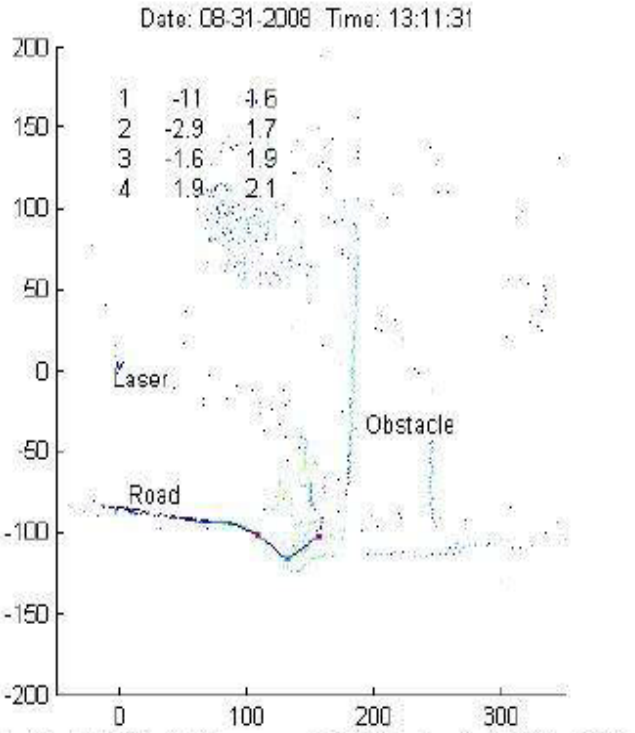
ADT :	2900	HRZL CURVE	No
SPEED LIMIT(mph)	45	TOTAL AVAL DISTANCE(ft)	7.37
DIRECTION	NW	APPLICABLE CLEAR ZONE(ft)	1.6
INSPECTION TIM	13:11:31	DESIRED CLEAR ZONE(ft)	12-14
INSPECTION DATE:	8/31/2008		

Minimum Clearzone Not Met

Lexington SC **16Tree**

ANO

LASER MEASUREMENT:



Total dist: 7.37 feet, Clear zone: 1.60 feet, desired 12.00 - 14.00

SITE DETAILS:

SITE ID:	
NSITE:	16Tree
LONGITUDE:	-81206347
LATITUDE:	34032778
PRIMARY NAME:	Corley Mill RD
SECONDARY NAME:	State Road S 32 68
ROUTE TYPE:	Secondary
LANE	2
SPEED LIMIT (mph):	45
ADT:	2900
DIRECTION:	NW
HRZL CURVE:	No

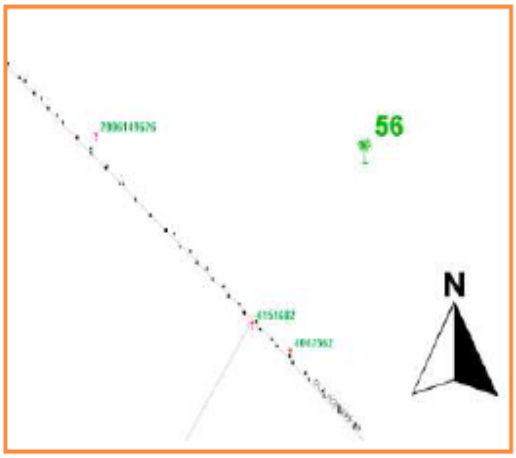
VIDEO -LOG PHOTO

Richland SC **56Tree**

SITE DETAILS

SITE ID:	56
NSIT	56Tree
LATITUDE	33927223
LONGITUDE	-80897249
PRIMARY NAME:	Old Hopkins RD
SECONDARY NAME:	
ROUTE TYPE:	Secondary
LANES:	2
SPEED LIMIT (mph):	45
ADT:	1800
HRZL. CURVE	No
DIRECTION:	NW

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
56Tree	4025127	Tree	Possible
56Tree	4047562	Tree	Not Injured
56Tree	4102604	Tree	Not Injured
56Tree	4151682	Tree	Possible
56Tree	2005014002	Tree	Not Injured
56Tree	2006119206	Tree	Possible
56Tree	2006134289	Tree	Not Injured
56Tree	2006149626	Tree	Possible

CLEARZONE ANALYSIS

ANO: 4047562

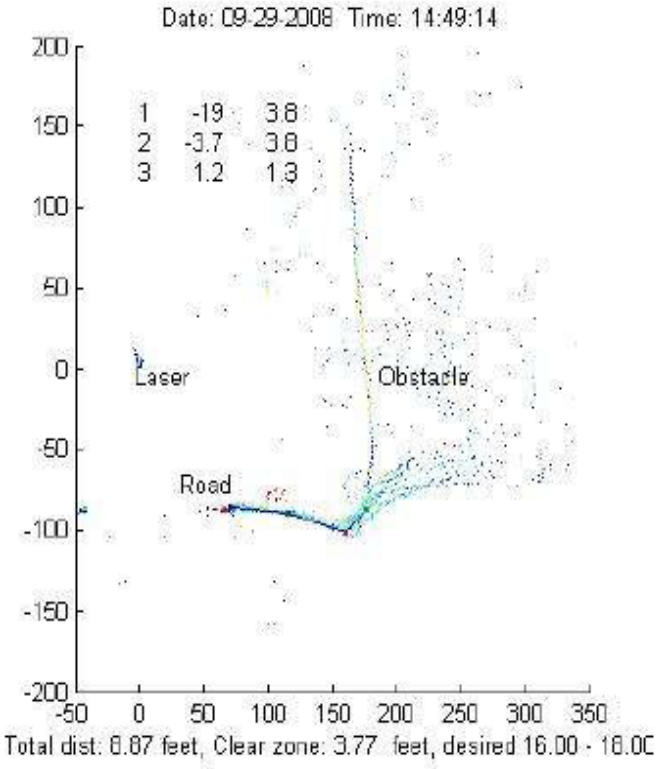
ADT :	1800	HRZL CURVE	No
SPEED LIMIT(mph)	45	TOTAL AVAL DISTANCE(ft)	8.87
DIRECTION	NW	APPLICABLE CLEAR ZONE(ft)	3.77
INSPECTION TIM	14:49:14	DESIRED CLEAR ZONE(ft)	16-18
INSPECTION DATE:	9/30/2008		

Minimum Clearzone Not Met

Richland SC **56Tree**

ANO

LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	56Tree
LONGITUDE:	-80897249
LATITUDE:	33922250
PRIMARY NAME:	Old Hopkins RD
SECONDARY NAME:	
ROUTE TYPE:	Secondary
LANE	2
SPEED LIMIT (mph):	45
ADT:	1800
DIRECTION:	NW
HRZL CURVE:	No

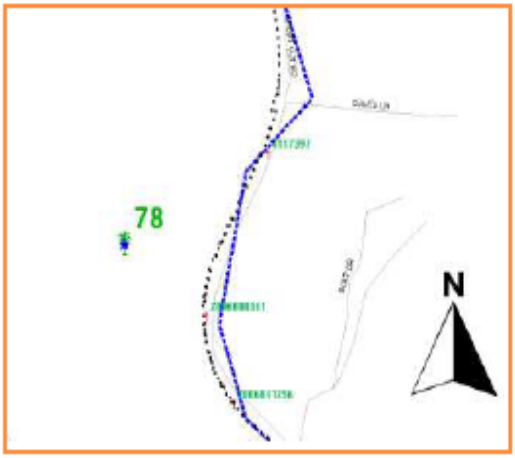
VIDEO -LOG PHOTO

Berkeley SC **78Tree**

SITE DETAILS

SITE ID:	78
NSIT	78Tree
LATITUDE	33339621
LONGITUDE	-80173204
PRIMARY NAME:	Short Cut RD
SECONDARY NAME:	
ROUTE TYPE:	Secondary
LANES:	2
SPEED LIMIT (mph):	45
ADT:	1600
HRZL. CURVE	Yes
DIRECTION:	NE

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
78Tree	4038202	Tree	Non-incapacitating
78Tree	4085529	Tree	Possible
78Tree	4102443	Tree	Possible
78Tree	4117397	Motor Vehicle(In Transport)	Fatal
78Tree	4145544	Tree	Possible
78Tree	2005050855	Tree	Non-incapacitating
78Tree	2006008341	Tree	Not Injured
78Tree	2006041256	Tree	Non-incapacitating

CLEARZONE ANALYSIS

ANO: 4117397

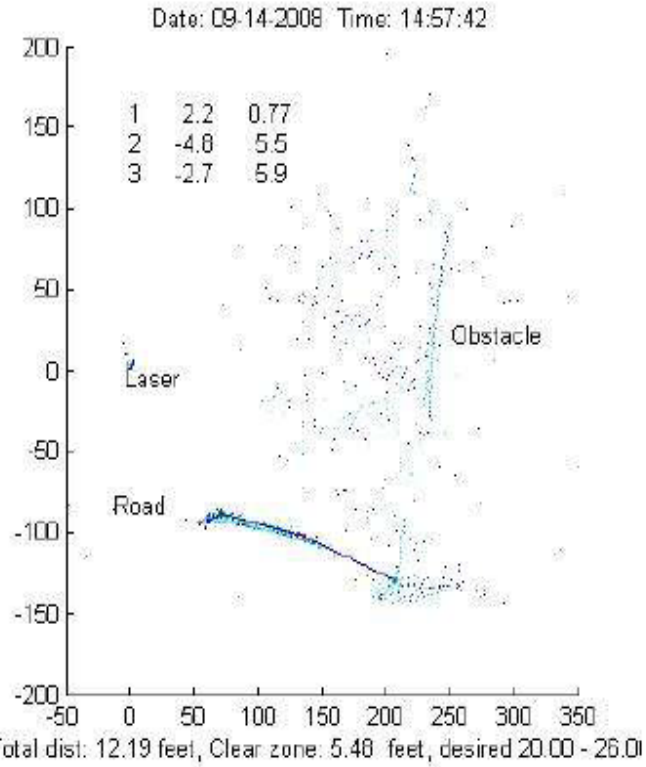
ADT :	1600	HRZL CURVE	Yes
SPEED LIMIT(mph)	45	TOTAL AVAL DISTANCE(ft)	12.19
DIRECTION	NE	APPLICABLE CLEAR ZONE(ft)	5.48
INSPECTION TIM	14:57:42	DESIRED CLEAR ZONE(ft)	20-26
INSPECTION DATE:	9/14/2008		

Minimum Clearzone Not Met

Berkeley SC **78Tree**

ANO

LASER MEASUREMENT:



Total dist: 12.19 feet, Clear zone: 5.48 feet, desired 20.00 - 26.01

SITE DETAILS:

SITE ID:	
NSITE:	78Tree
LONGITUDE:	-80173204
LATITUDE:	33323694
PRIMARY NAME:	Short Cut RD
SECONDARY NAME:	
ROUTE TYPE:	Secondary
LANE	2
SPEED LIMIT (mph):	45
ADT:	1600
DIRECTION:	NE
HRZL CURVE:	Yes

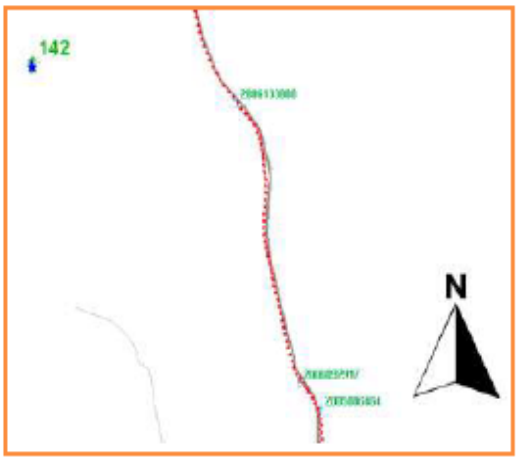
VIDEO -LOG PHOTO

Aiken SC **142Tree**

SITE DETAILS

SITE ID:	142
NSIT	142Tree
LATITUDE	33587616
LONGITUDE	-81816496
PRIMARY NAME:	Senn St
SECONDARY NAME:	State Highway 191
ROUTE TYPE:	SC Primary
LANES:	2
SPEED LIMIT (mph):	30
ADT:	1900
HRZL. CURVE	No
DIRECTION:	NW

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
142Tree	2005009466	Tree	Possible
142Tree	2005086464	Tree	Not Injured
142Tree	2006006773	Tree	Not Injured
142Tree	2006092917	Tree	Possible
142Tree	2006133008	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 2006092917

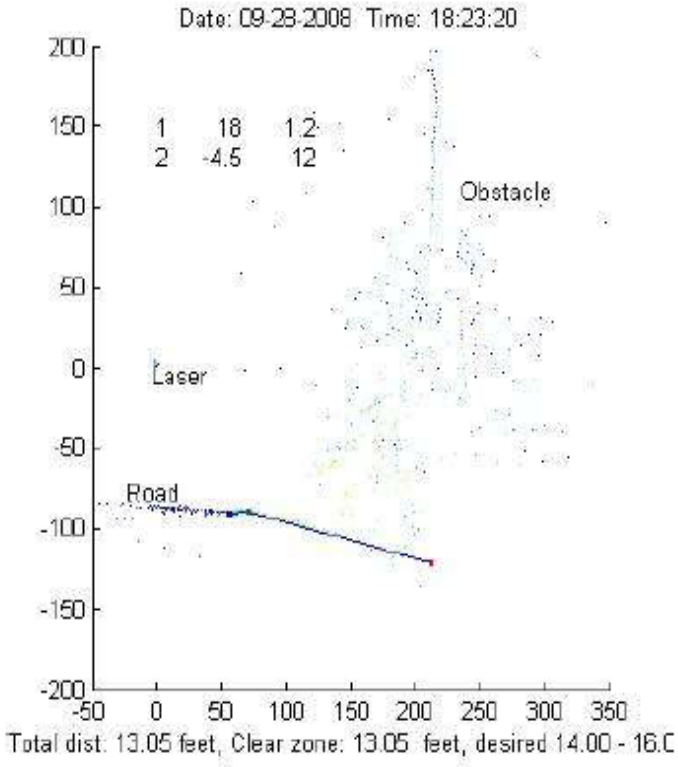
ADT :	1900	HRZL CURVE	No
SPEED LIMIT(mph)	30	TOTAL AVAL DISTANCE(ft)	13.05
DIRECTION	NW	APPLICABLE CLEAR ZONE(ft)	13.05
INSPECTION TIM	18:23:20	DESIRED CLEAR ZONE(ft)	14-16
INSPECTION DATE:	9/28/2008		

Minimum Clearzone Not Met

Aiken SC **142Tree**

ANO

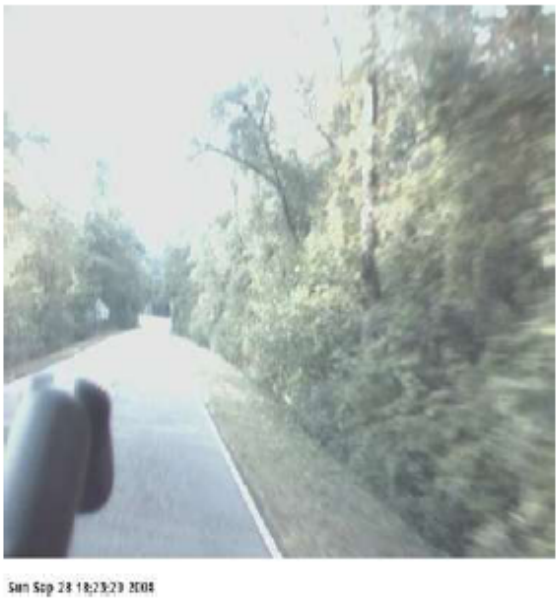
LASER MEASUREMENT:



SITE DETAILS:

SITE ID:	
NSITE:	142Tree
LONGITUDE:	-81816496
LATITUDE:	33579556
PRIMARY NAME:	Senn St
SECONDARY NAME:	State Highway 191
ROUTE TYPE:	SC Primary
LANE	2
SPEED LIMIT (mph):	30
ADT:	1900
DIRECTION:	NW
HRZL CURVE:	No

VIDEO -LOG PHOTO

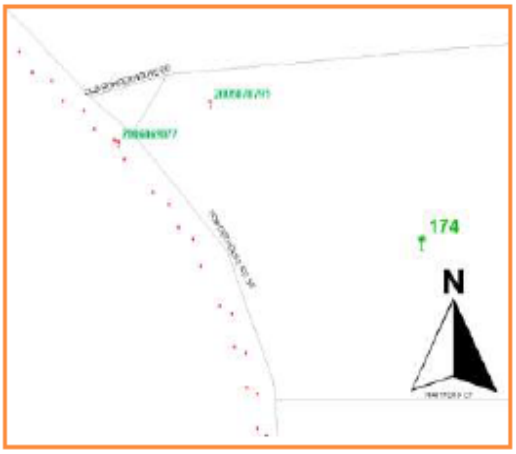


Aiken SC **174Tree**

SITE DETAILS

SITE ID:	174
NSIT	174Tree
LATITUDE	33522356
LONGITUDE	-81696757
PRIMARY NAME:	owderHouse RD SE
SECONDARY NAME:	State Highway 440
ROUTE TYPE:	Secondary
LANES:	2
SPEED LIMIT (mph):	35
ADT:	1760
HRZL. CURVE	Yes
DIRECTION:	SE

GIS:



Summary

NSITE ID	ANO	FIRST HARMFULL EVENT	CRASH SEVERITY
174Tree	4021581	Tree	Not Injured
174Tree	2005025864	Tree	Possible
174Tree	2005033081	Tree	Not Injured
174Tree	2005078791	Tree	Non-incapacitating
174Tree	2005123933	Tree	Possible
174Tree	2006069077	Tree	Not Injured

CLEARZONE ANALYSIS

ANO: 2005078791

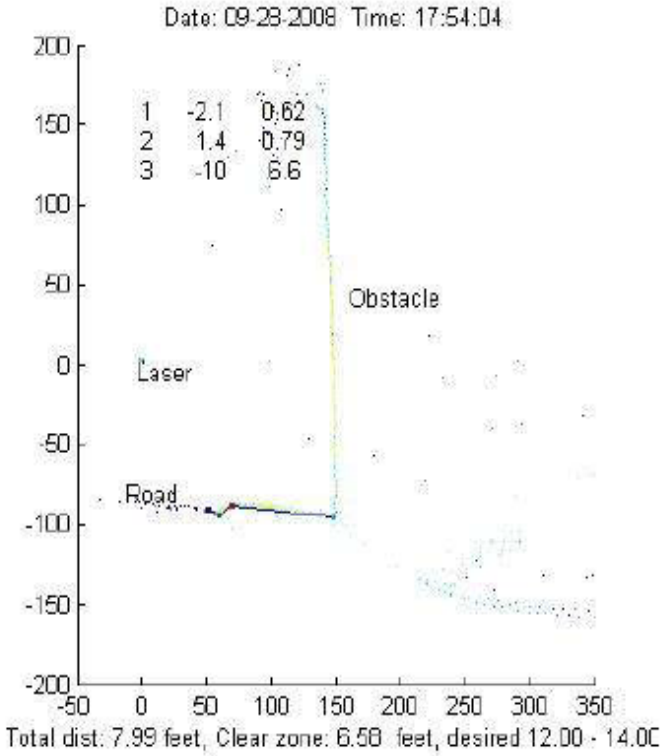
ADT :	1760	HRZL CURVE	Yes
SPEED LIMIT(mph)	35	TOTAL AVAL DISTANCE(ft)	7.99
DIRECTION	SE	APPLICABLE CLEAR ZONE(ft)	6.58
INSPECTION TIM	17:54:04	DESIRED CLEAR ZONE(ft)	12-14
INSPECTION DATE:	9/28/2008		

Minimum Clearzone Not Met

Aiken SC **174Tree**

ANO

LASER MEASUREMENT:



Total dist: 7.99 feet, Clear zone: 6.58 feet, desired 12.00 - 14.00

SITE DETAILS:

SITE ID:	
NSITE:	174Tree
LONGITUDE:	-81696757
LATITUDE:	33525472
PRIMARY NAME:	owderHouse RD SE
SECONDARY NAME:	State Highway 440
ROUTE TYPE:	Secondary
LANE	2
SPEED LIMIT (mph):	35
ADT:	1760
DIRECTION:	SE
HRZL CURVE:	Yes

VIDEO -LOG PHOTO

APPENDIX D-BENEFIT/COST ANALYSIS REPORTS FROM ROADSIDE SAFETY ANALYSIS PROGRAM

APPENDIX D (1): BENEFIT/COST RATIO REPORT

Roadside Safety Analysis Program Version 2.0.3

Date: December 10, 2009 **Time:** 17:11:07PM

Benefit/Cost Ratio Report

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternative	Description
1	Existing Conditions
2	Clear trees 7ft from edge of roadway
3	Clear trees 14ft from the edge of roadway
4	Guardrail Protection

	Alternative			
Alternative	1	2	3	4
1	0.00	4.63	3.83	-1.92
2	0.00	0.00	3.23	-3.47
3	0.00	0.00	0.00	-6.57
4	0.00	0.00	0.00	0.00

APPENDIX D (2): ALTERNATIVE COST REPORT

Roadside Safety Analysis Program Version 2.0.3

Date: December 10, 2009 **Time:** 17:13:52PM

Alternative Cost Report

Page: 2

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternative	Description
1	Existing Conditions
2	Clear trees 7ft from edge of roadway
3	Clear trees 14ft from the edge of roadway
4	Guardrail Protection

Alternative	Expected Crash Frequency (Acc/Yr)	Annual Crash Cost ($)	Annual Installation Cost ($)	Annual Maintenance Cost ($)	Annual Repair Cost ($)
1	0.039377	1462.40	0.00	0.00	0.00
2	0.015593	995.31	30.17	70.69	0.00
3	0.006827	556.80	70.78	165.85	0.00
4	0.059810	2480.96	526.50	0.00	2.99

APPENDIX D (3): FEATURE COST REPORT

Roadside Safety Analysis Program Version 2.0.3

Date: December 10, 2009 **Time:** 17:15:01PM

Feature Cost Report

Page: 3

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternative: 1
Description: Existing Conditions

Feature	Distance From Beginning Of First Segment	Expected Crash Freq (Acc/Year)	Average Severity	Annual Crash Cost ($)	Category	Type
1.1	0.0	0.001734	2.74	137.85	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.2	7.0	0.000922	2.59	18.13	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.3	14.0	0.001111	2.74	25.84	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.4	21.0	0.001135	2.64	29.34	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.5	28.0	0.001082	2.58	24.47	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.6	35.0	0.000974	2.56	24.94	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.7	42.0	0.000956	2.57	25.43	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.8	49.0	0.000953	2.73	34.00	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.9	56.0	0.000932	2.71	31.78	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.10	63.0	0.000921	2.71	33.04	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.11	70.0	0.000871	2.70	28.94	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.12	77.0	0.000855	2.63	27.97	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.13	84.0	0.000843	2.68	27.79	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.14	91.0	0.000832	2.69	32.16	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.15	98.0	0.000824	2.70	28.26	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.16	105.0	0.000801	2.62	27.09	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.17	112.0	0.000800	2.61	25.82	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.18	119.0	0.000799	2.68	30.16	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.19	126.0	0.000791	2.65	30.31	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.20	133.0	0.000779	2.70	29.14	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.21	140.0	0.000787	2.71	29.22	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.22	147.0	0.000772	2.65	29.23	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.23	154.0	0.000769	2.62	28.57	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.24	161.0	0.000773	2.69	31.80	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.25	168.0	0.000768	2.69	30.39	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.26	175.0	0.000770	2.68	29.11	Fixed Objects	Tree, 150 mm (6 in.) Dia.

APPENDIX D (3): FEATURE COST REPORT (CONTINUED...)

Roadside Safety Analysis Program Version 2.0.3

Date: December 10, 2009 **Time:** 17:20:36PM

Feature Cost Report

Page: 4

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternative: 2
Description: Clear trees 7ft from edge of roadway

Feature	Distance From Beginning Of First Segment	Expected Crash Freq (Acc/Year)	Average Severity	Annual Crash Cost ($)	Category	Type
1.1	0.0	0.000595	2.67	82.18	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.2	7.0	0.000276	2.67	14.32	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.3	14.0	0.000290	2.76	16.49	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.4	21.0	0.000352	2.98	28.08	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.5	28.0	0.000369	2.75	18.13	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.6	35.0	0.000374	2.59	15.98	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.7	42.0	0.000372	2.55	15.96	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.8	49.0	0.000363	2.59	18.13	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.9	56.0	0.000361	2.56	19.09	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.10	63.0	0.000356	2.63	18.27	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.11	70.0	0.000353	2.67	20.13	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.12	77.0	0.000345	2.75	24.14	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.13	84.0	0.000337	2.74	23.79	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.14	91.0	0.000334	2.54	18.02	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.15	98.0	0.000327	2.69	20.60	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.16	105.0	0.000324	2.71	22.29	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.17	112.0	0.000326	2.62	17.35	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.18	119.0	0.000328	2.88	23.40	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.19	126.0	0.000323	2.61	16.81	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.20	133.0	0.000323	2.60	18.14	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.21	140.0	0.000320	2.47	15.55	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.22	147.0	0.000321	2.70	19.64	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.23	154.0	0.000332	2.63	19.92	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.24	161.0	0.000329	2.68	20.33	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.25	168.0	0.000352	2.73	22.25	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.26	175.0	0.000356	2.76	22.21	Fixed Objects	Tree, 150 mm (6 in.) Dia.

APPENDIX D (3): FEATURE COST REPORT (CONTINUED...)

Date: December 10, 2009 **Time:** 17:26:49PM

Feature Cost Report

Page: 5

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternative: 3
Description: Clear trees 14ft from the edge of roadway

Feature	Distance From Beginning Of First Segment	Expected Crash Freq (Acc/Year)	Average Severity	Annual Crash Cost ($)	Category	Type
1.1	0.0	0.000215	2.70	29.42	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.2	7.0	0.000121	2.62	8.28	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.3	14.0	0.000126	2.66	9.18	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.4	21.0	0.000127	2.78	8.98	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.5	28.0	0.000140	2.63	9.42	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.6	35.0	0.000153	2.75	11.62	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.7	42.0	0.000159	2.81	11.82	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.8	49.0	0.000166	2.74	13.18	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.9	56.0	0.000161	2.77	11.75	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.10	63.0	0.000160	2.61	9.73	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.11	70.0	0.000166	2.78	12.89	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.12	77.0	0.000164	2.59	11.62	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.13	84.0	0.000159	2.77	11.44	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.14	91.0	0.000156	2.68	11.08	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.15	98.0	0.000155	2.70	12.65	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.16	105.0	0.000155	2.69	12.73	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.17	112.0	0.000162	2.83	13.38	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.18	119.0	0.000160	2.62	11.16	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.19	126.0	0.000160	2.61	12.34	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.20	133.0	0.000158	2.70	13.19	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.21	140.0	0.000147	2.56	11.58	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.22	147.0	0.000147	2.69	11.19	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.23	154.0	0.000144	2.72	13.11	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.24	161.0	0.000145	2.62	11.27	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.25	168.0	0.000145	2.57	9.84	Fixed Objects	Tree, 150 mm (6 in.) Dia.
1.26	175.0	0.000142	2.72	12.67	Fixed Objects	Tree, 150 mm (6 in.) Dia.

APPENDIX D (3): FEATURE COST REPORT (CONTINUED...)

Date: December 10, 2009 **Time:** 17:27:59PM

Feature Cost Report

Page: 6

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternative: 4
Description: **Guardrail Protection**

Feature	Distance From Beginning Of First Segment	Expected Crash Freq (Acc/Year)	Average Severity	Annual Crash Cost ($)	Category	Type
1.1	0.0	0.059810	2.39	2480.96	Longitudinal Barriers	TL-1 Guardrail

APPENDIX D (4): INPUT DATA REPORT

Date: December 10, 2009 **Time:** 17:30:45PM

Input Data Report

Page: 7

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternavtive 1[Baseline(Existing)Condition]

Description	Existing Conditions
Life(years)	25
Total Installation Cost ($)	0.00
Annual Maintenance Cost ($)	0.00
Discount Rate	4.00
Area Type	Rural
Functional Class	Minor Arterial
Highway Type	Two-Way, Undivided
Number of Lanes	2
Lane Width(ft)	11.0
Shoulder Width(ft)	4.0
Speed Limit(mph)	45.0
Nominal Percent Truck(%)	2.0
ADT	3780
Traffic Growth Factor(%)	3.0
Encroachment Rate Adjustment Factor	1
Random Seed Number	76778000 (User Specified)

Segment	Length(ft)	Median Width(ft)	Percent Grade(%)	Curvature Direction	Curvature Radius(ft)
1	329.0	0.0	0.0	None	

APPENDIX D (4): INPUT DATA REPORT (CONTINUED…)

Date: December 10, 2009 **Time:** 17:31:47PM

Input Data Report

Page: 8

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternative **1 [Baseline(Existing) Conditions]**

Feature	Category	Type
1	Fixed Objects	Tree, 150 mm (6 in.) Dia.

APPENDIX D (4): INPUT DATA REPORT (CONTINUED…)

Date: December 10, 2009 **Time:** 17:34:33PM

Input Data Report

Page: 9

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternative **1 [Baseline(Existing) Conditions]**

Feature	Length(ft)	Width(ft)	Flare Rate	Location	Offset(ft)	Distance(ft)	Repetitions	Spacing(ft)
1	0.5	0.5	0.000	Right	1.8	0.0	47	7.0

APPENDIX D (4): INPUT DATA REPORT (CONTINUED…)

Date: December 10, 2009 **Time:** 17:36:38PM

Input Data Report

Page: 10

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternavtive **2**

Description	Clear trees 7ft from edge of roadway
Life(years)	25
Total Installation Cost ($)	471.29
Annual Maintenance Cost ($)	70.69
Discount Rate	4.00
Area Type	Rural
Functional Class	Minor Arterial
Highway Type	Two-Way, Undivided
Number of Lanes	2
Lane Width(ft)	11.0
Shoulder Width(ft)	4.0
Speed Limit(mph)	45.0
Nominal Percent Truck(%)	2.0
ADT	3780
Traffic Growth Factor(%)	3.0
Encroachment Rate Adjustment Factor	1
Random Seed Number	76778000 (User Specified)

Segment	Length(ft)	Median Width(ft)	Percent Grade(%)	Curvature Direction	Curvature Radius(ft)
1	329.0	0.0	0.0	None	

APPENDIX D (4): INPUT DATA REPORT (CONTINUED…)

Date: December 10, 2009 **Time:** 17:38:04PM

Input Data Report

Page: 11

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternative **2**

Feature	Category	Type
1	Fixed Objects	Tree, 150 mm (6 in.) Dia.

APPENDIX D (4): INPUT DATA REPORT (CONTINUED…)

Roadside Safety Analysis Program Version 2.0.3

Date: December 10, 2009 **Time:** 17:40:51PM

Input Data Report

Page: 12

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternative 2

Feature	Length(ft)	Width(ft)	Flare Rate	Location	Offset(ft)	Distance(ft)	Repetitions	Spacing(ft)
1	0.5	0.5	0.000	Right	7.0	0.0	47	7.0

APPENDIX D (4): INPUT DATA REPORT (CONTINUED…)

Roadside Safety Analysis Program Version 2.0.3

Date: December 10, 2009 **Time:** 17:52:42PM

Input Data Report

Page: 13

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternavtive **3**

Description	Clear trees 14ft from the edge of roadway
Life(years)	25
Total Installation Cost ($)	1105.73
Annual Maintenance Cost ($)	165.85
Discount Rate	4.00
Area Type	Rural
Functional Class	Minor Arterial
Highway Type	Two-Way, Undivided
Number of Lanes	2
Lane Width(ft)	11.0
Shoulder Width(ft)	4.0
Speed Limit(mph)	45.0
Nominal Percent Truck(%)	2.0
ADT	3780
Traffic Growth Factor(%)	3.0
Encroachment Rate Adjustment Factor	1
Random Seed Number	76778000 (User Specified)

Segment	Length(ft)	Median Width(ft)	Percent Grade(%)	Curvature Direction	Curvature Radius(ft)
1	329.0	0.0	0.0	None	

APPENDIX D (4): INPUT DATA REPORT (CONTINUED…)

Roadside Safety Analysis Program Version 2.0.3

Date: December 10, 2009 **Time:** 17:53:38PM

Input Data Report

Page: 14

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternative **3**

Feature	Category	Type
1	Fixed Objects	Tree, 150 mm (6 in.) Dia.

APPENDIX D (4): INPUT DATA REPORT (CONTINUED…)

Roadside Safety Analysis Program Version 2.0.3

Date: December 10, 2009 **Time:** 17:54:28PM

Input Data Report

Page: 15

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternative **3**

Feature	Length(ft)	Width(ft)	Flare Rate	Location	Offset(ft)	Distance(ft)	Repetitions	Spacing(ft)
1	0.5	0.5	0.000	Right	14.0	0.0	47	7.0

APPENDIX D (4): INPUT DATA REPORT (CONTINUED…)

Roadside Safety Analysis Program Version 2.0.3

Date: December 10, 2009 **Time:** 17:55:14PM

Input Data Report

Page: 16

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternavtive 4

Description	Guardrail Protection
Life(years)	25
Total Installation Cost ($)	8225.00
Annual Maintenance Cost ($)	0.00
Discount Rate	4.00
Area Type	Rural
Functional Class	Minor Arterial
Highway Type	Two-Way, Undivided
Number of Lanes	2
Lane Width(ft)	11.0
Shoulder Width(ft)	4.0
Speed Limit(mph)	45.0
Nominal Percent Trucks(%)	2.0
ADT	3780
Traffic Growth Factor(%)	3.0
Encroachment Rate Adjustment Factor	1
Random Seed Number	76778000 (User Specified)

Segment	Length(ft)	Median Width(ft)	Percent Grade(%)	Curvature Direction	Curvature Radius(ft)
1	329.0	0.0	0.0	None	

APPENDIX D (4): INPUT DATA REPORT (CONTINUED…)

Roadside Safety Analysis Program Version 2.0.3

Date: December 10, 2009 **Time:** 17:57:51PM

Input Data Report

Page: 17

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternative **4**

Feature	Category	Type
1	Longitudinal Barriers	TL-1 Guardrail

APPENDIX D (4): INPUT DATA REPORT (CONTINUED…)

Roadside Safety Analysis Program Version 2.0.3

Date: December 10, 2009 **Time:** 17:58:37PM

Input Data Report

Page: 18

File Name: BenefitCost_Analysis_112209_1.rpd
Project Description: New Project

Alternative 4

Feature	Length(ft)	Width(ft)	Flare Rate	Location	Offset(ft)	Distance(ft)	Repetitions	Spacing(ft)
1	329.0	1.5	0.000	Right	4.0	0.0		